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Eastern Pacific Expeditions of the New York  
 Zoological Society. XXII.  
 Mollusks from the West Coast of Mexico and Central America.  
 Part I.<sup>1</sup>

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(Plates I & II).

[This is the twenty-second of a series of papers dealing with the collections of the Eastern Pacific Expeditions of the New York Zoological Society made under the direction of William Beebe. The present paper is concerned with specimens taken on the Templeton Crocker Expedition (1936) and the Eastern Pacific *Zaca* Expedition (1937-1938). For data on localities, dates, dredges, etc., refer to *Zoologica*, Vol. XXII, No. 2, pp. 33-46, and Vol. XXIII, No. 14, pp. 287-298.]

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## INTRODUCTION.

Two expeditions to the eastern tropical Pacific were conducted by Mr. Templeton Crocker and Dr. William Beebe under the auspices of the New York Zoological Society. The means of transportation for these trips was Mr. Crocker's yacht *Zaca*. The first of these left San Diego, California, on March 19, 1936. Dredgings were made at many localities from a short distance south of San Diego to Cape San Lucas and into the Gulf of California, north to Santa Inez Bay. Clarion Island in the Revillagigedo group was also visited and some dredgings and shore collections made. At certain places shore collecting was conducted but a large part of the mollusks obtained by this expedition resulted from dredging, mostly from the southern part of the Gulf of California. The depth varied from 1 to 600 fathoms but most of the collection was obtained in less than 100 fathoms. This expedition returned to San Diego, California, on May 25, 1936. A paper by Beebe<sup>2</sup> contains an itinerary, list of stations and nets and dredges used, and a general

<sup>2</sup> Beebe, W. The Templeton Crocker Expedition. II. Introduction, Itinerary, List of Stations, Nets and Dredges. *Zoologica, Sci. Contrib. New York Zool. Soc.*, Vol. 22, pt. 1, April 5, 1937, pp. 33-46, 8 text figs.

account of the trip by the same author<sup>3</sup>, appeared in a book entitled "Zaca Venture."

The second expedition by Messrs. Crocker and Beebe left San Diego, California, on November 6, 1937. This cruise took the *Zaca* along western Lower California and the west coast of Mexico as far south as Gorgona Island, Colombia. Dredging and shore collecting on this trip yielded much fine research material. The *Zaca* returned to California and the party disbanded at Balboa on April 5, 1938. An account of the itinerary, list of stations, nets and dredges on this trip is contained in a paper by Beebe<sup>4</sup>.

The present collections, then, are almost entirely from tropical and sub-tropical western North and Central America between 30° and 3° North Latitude. Collecting over such an extensive area has naturally brought to light many interesting occurrences, and a number of new species.

Several important extensions in range were discovered during the work. Especially noteworthy are those species heretofore known from more northern latitudes but now found to range south to Cape San Lucas. Also, numerous species, previously known to occur in more southern latitudes were found in the Gulf of California. An illustration of this is the discovery in the Gulf of *Cancellaria cumingiana* Petit, heretofore known only from Ecuador. Another interesting occurrence is that of a single valve of *Cardium magnum* Linnaeus, a species well known off Florida, which was found at Santa Inez Bay. It seems possible that this may have been transported to the west coast by some fortuitous means.

Through an arrangement with Dr. Beebe the mollusks were submitted to the authors for identification and description. Types of new species and figured specimens have been deposited in the type series of the California Academy of Sciences; duplicates of some of the other species and certain unique specimens were retained in the same institution for the purpose of comparative studies of tropical west American mollusks now under way by the authors. The bulk of the collection accompanied by identifications has been returned to Dr. Beebe of the New York Zoological Society.

Numerous papers contain records of species inhabiting the Gulf of California but the present collection revealed many additional ones not heretofore known to live in that region. There are also a very considerable number of forms previously unknown. Although it has been generally recognized that the Gulf of California contains one of the richest known molluscan faunas, the meticulous care taken by Messrs. Crocker and Beebe in recording locality data makes this collection one of the most important ever made in the area.

#### SCOPE AND PLAN OF PRESENT REPORT.

The preparation of a paper on the present collections offered problems which have required considerable time. No checklist containing the majority of the species known to occur between San Diego and Panama has been published. Several papers dealing with the mollusks of this region exist but any systematic work required consultation of many scattered references and even in these many species have never been illustrated. After due consideration and consultation the authors decided to prepare the paper with the idea in mind that it should be useful not only as a checklist of the present collection but also containing references and illustrations. We therefore have prepared a systematic report with all pertinent references to each

<sup>3</sup> Beebe, W. *Zaca Venture* (Harcourt Brace & Co., New York City, New York). 1938, 303 pp. + I-XVI. 23 illustrations.

<sup>4</sup> Beebe, W. *Eastern Pacific Expeditions of the New York Zoological Society, XIV. Introduction, Itinerary, List of Stations, Nets and Dredges of the Eastern Pacific Zaca Expedition, 1937-1938. Zoologica, Sci. Contrib. New York Zool Soc., Vol. 23, pt. 3, September 28, 1938, pp. 287-298, (2 maps pp. 290, 291).*

species gathered together in the synonymy. The total lack of a complete checklist of the tropical west American mollusks has necessitated a compilation of all the species known to have been described or cited as occurring in that region. Although it would not be possible in the time available to monograph or even give a critical review of all the species, the great utility of a complete catalogue justifies, in our opinion, the inclusion herein of as complete a census as possible. In some cases we have included additional species which are not known to occur in the tropics but which are related to tropical forms, or which for systematic reasons it seems desirable to include. Keys to the genera of certain of the families, and, where information is adequate, keys to species, have been included. However, in many cases, present knowledge does not justify an attempt to furnish a key. The present unstable nomenclature<sup>5</sup> of mollusks has led the authors to adopt a conservative course in dealing with nomenclatorial problems in connection with this work. Illustrations are planned for all species represented in the collection which are heretofore unillustrated or of which the illustration is not readily available. The range, type locality, repertory of the type where known to us, collecting stations, notes on the species and descriptions of new species are also included. At present it is planned that the entire work will appear at intervals, each part to include one or more families, beginning with the Pelecypoda. In the final part of the paper we hope to present general observations on the collection as a whole and remarks regarding significant features observed regarding distribution; and if feasible, a bibliography of many of the important papers which it is necessary to consult in a study of mollusks of tropical western North America.

At the beginning of this work it was planned that Dr. G. Dallas Hanna, Curator of the Department of Paleontology of the California Academy of Sciences, could collaborate in this work. Unfortunately the work had only begun when duties called him to Alaska and elsewhere which then left the preparation to the present authors. A few species were described during the early stages of the work and in these we have happily been able to include Dr. Hanna as a co-author.

#### ACKNOWLEDGEMENTS.

We wish here to thank Mr. Templeton Crocker, owner of the yacht *Zaca*, for his generosity and interest which made this paper possible. His collecting and careful recording of locality data have been of great help in work on this collection. To Dr. William Beebe we extend our thanks for his unflinching interest and cooperation throughout this work. His collecting and recording of locality information is a model of its kind. To Dr. G. Dallas Hanna we extend our thanks for his cooperation and unflinching help in advising us regarding many problems which have arisen during the preparation of the paper. His advice and help have been generously available at all times and are greatly appreciated by the authors. Mr. A. G. Smith, Berkeley, California, Dr. U. S. Grant IV, of the University of California at Los Angeles, and Dr. H. G. Schenck and Dr. A. M. Keen of Stanford University, have furnished information regarding certain of the species. The secretarial work of Miss Winifred O'Neill and Miss Alta Holton and the preparation of photographs by Mr. Frank L. Rogers incident to the preparation of this portion of the report is herewith acknowledged. This was done during the course of Federal Works Progress Administration Project No. 8569.

<sup>5</sup> Henderson, J. Our Unstable Biological Classification and Nomenclature. Presidential Address, Fourth Annual Meeting of the American Malacological Union at Stanford University, June 26-28, 1934, pp. 1-13.

Other papers useful in dealing with nomenclatorial problems are: Procedure in Taxonomy, including a Reprint of the International rules of Zoological Nomenclature with Summaries of Opinions Rendered to date, completely Indexed. By E. T. Schenk and J. H. McMasters. Stanford University Press, Stanford University, California, 1936, VII + 1-72. Terminology of Types. By D. L. Frizzell. *Amer. Midl. Nat.*, Vol. 14, no. 6, 1933, pp. 637-668.

## Class Pelecypoda.

The pelecypods or bivalve shells are well known to collectors and systematists. Oysters and scallops are examples of edible pelecypods of economic importance. Marine species occur in all oceans. The total number is not exactly known but there are perhaps about 8,000 species. They are most numerous on the coasts of continents or on land masses which have formerly been connected with continental land masses. About 500 species are known to occur between Bering Sea and San Diego, California, and at least an equal or greater number exist between San Diego and Peru. The largest of all mollusks is the giant clam, *Tridacna gigas* Linnaeus<sup>6</sup>, which attains a length of 54 inches and a weight of more than 500 pounds. Some excellent manuals used in the classification and general arrangement of pelecypods are those of Tryon<sup>7</sup>, Chenu<sup>8</sup>, Fischer<sup>9</sup>, Woodward<sup>10</sup>, Dall<sup>11</sup> and Thiele<sup>12</sup>. In general, although with some exceptions, we have followed the arrangement used by Dall. The importance of the hinge in classification has been discussed by Neumayr<sup>13</sup> and by Dall<sup>14</sup>. The structure of shells has been discussed by Böggild<sup>15</sup> and others, and the coloration has been discussed by Bennett<sup>16</sup>. A useful general bibliography of literature dealing with the Pelecypoda is found in Dall's article on Mollusks in Eastman's Translation of Zittel's Text-book of Palaeontology and in recent papers on bivalves by Haas<sup>17</sup>. Additional

## Order Prionodesmacea.

## Superfamily Solemyacea.

## Family Solemyidae.

The family Solemyidae is usually placed first in systematic arrangement of the pelecypods. The shell characters are quite different from the following group, the Nuculidae, and as pointed out by some authors, there is little evidence of relationship between the two groups. The gill-structure of the Solemyidae is believed by some writers to be due probably to specialization and not a remnant of a generalized style.

<sup>6</sup> See Hedley, C. A Revision of the Australian *Tridacna*. *Rec. Australian Museum*, Vol. 13, no. 4, April 12, 1921, pp. 163-172, pl. 27-34. See especially pp. 168-170. See also *Mem. Australian Mus.* 3, pt. 8, 1899, p. 505, and E. A. Smith, *Proc. Malacol. Soc. London*, Vol. 3, 1898, p. 112.

<sup>7</sup> Tryon, G. W. Structural and Systematic Conchology. Volume 3, 1884, Pelecypoda, pp. 116-353, pls. 104-133.

<sup>8</sup> Chenu, J. C. Manuel de Conchyliologie, Vol. 2, 1862, pp. 1-199, 1015 figs. in text.

<sup>9</sup> Fischer, P. Manuel de Conchyliologie, 1880-1887, pp. 1-1369, 23 pls. Pélécyposes, pp. 897-1187, pls. 16-23.

<sup>10</sup> Woodward, S. P. Manual of the Mollusca. Reprint of Fourth Edition (1880), 1910, Conchifera, pp. 393-507, pls. 16-23. Ap. to Manual of Mollusca by R. Tate, 1910, Conchifera, pp. 64-81.

<sup>11</sup> Dall, W. H. Text-Book of Palaeontology by K. von Zittel. Edited by C. R. Eastman, Vol. 1, 1913. Pelecypoda, pp. 422-507, Figs. 637-836 in text.

<sup>12</sup> Thiele, J. Handbuch der systematischen Weichtierkunde, (Verlag von Gustav Fischer. Jena), Teil 3, 1934, Bivalvia, pp. 782-948, figs. 788-867. Also, Handwörterbuch der Naturwissenschaften, Zweite Auflage, Bd. 1, 1931, Bivalvia, pp. 996-1010, figs. 1-8. See also Bivalvia (Paläontologie) by E. Jaworski, pp. 1010-1026, figs. 1-43.

<sup>13</sup> Neumayr, M. Zur Morphologie des Bivalvenschlosses. *Sitzungsber. Akad. Wiss. Wien*, Bd. 88, Abt. 1, 1883, pp. 385-419, 2 pls. — Beiträge zu einer Morphologischen Eintheilung der Bivalven. *Denkschr. Akad. Wiss. Wien*, Bd. 58, 1891, pp. 701-801.

<sup>14</sup> Dall, W. H. Tertiary Mollusks of Florida. A new classification of the Pelecypoda, etc. *Trans. Wagner Free Inst. Sci.*, Vol. 3, pt. 3, March, 1895, pp. 486-566.

<sup>15</sup> Böggild, G. B. The Shell Structure of the Mollusks. *D. Kgl. Danske Vidensk. Selsk. Skrifter Naturbidensk. og Math. Afd.*, 9 Raekke, II, 2, 1930, pp. 233-325, 15 pls., 10 figs. in text. See also Schenck, H. G., Literature on the Shell structure of Pelecypods. *Bull. Mus. Hist. Nat. Belg.*, Vol. 10, no. 34, 1934, pp. 1-20.

<sup>16</sup> Bennett, E. W. Coloration of Mollusca in relation to Light. *Rec. Canterbury Mus.*, Vol. 3, no. 3, November 23, 1928, pp. 185-197.

<sup>17</sup> Haas, F. Bivalvia (Muscheln) H. G. Bronns Klassen und Ordnungen des Tier-reichs, Bd. 3, Abt. III, 1 Lfrg., Leipzig, 1929, pp. 1-176; Bd. 3, Abt. III, 2 Lfrg., 1929, pp. 1-292. With bibliography; Bd. 3, Abt. III, 3 Lfrg., 1931, pp. 177-384; Bivalvia. Dr. H. G. Bronns Klassen und Ordnungen des Tier-reichs, Bd. 3, Abt. III, 4 Lfrg., Leipzig, 1933, pp. 385-544. Also pp. 12-141. Short bibliography; Bd. 3, Abt. III, 1 Lfrg., 1937, pp. 1-208; Bd. 3, Abt. III, 2 Lfrg., 1938, pp. 209-466.

references which deal with the fauna upon which this paper is based will be found in succeeding pages.

### Genus *Solemya* Lamarck.

*Solemya* Lamarck, Anim. s. Vert., Vol. 5, 1818, p. 488. Species in original list: *Solemya australis* and *Solemya mediterranea*. ———Dall, *Nautilus*, Vol. 22, no. 1, May, 1908, p. 1. "Type *S. australis* Lamarck." ———Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 361. *S. australis* Lamarck considered to be the type. ———Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 109. Type: *Solenomya mediterranea* Lamarck=*Solemya mediterranea* Lamarck=*Solemya togata* (Poli).

*Solenimya* Lamarck, Bowdich, Elem. Conch., Pt. 2, 1822, p. 8. "*Solenimya* (*Solemya*. Lam.) M." Sole species: *Solenimya australis* cited as fig. 17.

*Solenomya* Lamarck, Menke, Synop. Meth. Moll., 1830, p. 119. "(*Solemya*, Lam.)" Sole species: *Solenomya mediterranea* Lamarck. ———Children, *Quart. Jour. Lit. Sci. and Arts*, Vol. 14, January 1823, p. 300 (reprint p. 27). Reprint by Kennard, Salisbury and Woodward, *Smithson. Misc. Coll.*, Vol. 82, no. 17, July 11, 1931, p. 7. Type species: *S. mediterranea* Lamarck.

Type (designated by Children): *Solenomya mediterranea* Lamarck. [= *Solemya mediterranea* Lamarck, Anim. s. Vert., Vol. 5, 1818, p. 489. Ref. to "Poli, test. 2, p. 42, et vol. 1. tab. 15, f. 20"; "Solen. Encycl. pl. 225, f. 4." "Habite la Méditerranée, dans le sable." Referred to *Solenomya togata* Poli by Bucquoy, Dautzenberg & Dollfus, *Moll. Mar. Roussillon*, Vol. 2, 1898, p. 718, pl. 92, figs. 8, 9, 10. Mediterranean; Adriatic; Atlantic; Senegal; Madeira].

Shell elongate, *Solen*-shaped, gaping at each end, epidermis dark, horny and extending beyond the ventral margins; umbos posterior; ligament amphidetic, chiefly internal; hinge edentulous with an obliquely inclined chondrophore, below which is an internal rib on the inner surface of the valve; pallial line obscure. Outer layer of shell composed of long prismatic cells, nearly parallel with surface and mingled with dark cells as in *Pinna*; inner layer also cellular.

Dall<sup>18</sup> has published a revision of the Solemyidae.

*Solemya* has been recorded from Paleozoic to Recent (Carboniferous and possibly Silurian to Recent). The genus has been cited from the Eocene of California by Clark & Woodford<sup>19</sup> and it also occurs from upper Oligocene or lower Miocene to Recent in western North America. *Solemya* (*Solemya*) *lomitensis* Olsson<sup>20</sup> has been described from the Oligocene of Peru, and Marwick<sup>21</sup> has recorded the genus from the lower Miocene of New Zealand. It also occurs in the Cenozoic of various other parts of the world.

In *Solemyarina* Iredale<sup>22</sup> with the type *S. velesiana* Iredale "The median rib is not curved, but is angulated posteriorly, while the anterior portion of the ligament is small and linear and the posterior portion is small and sub-linear, the posterior muscle scar free" (Iredale, 1939).

*Zesolemya* was proposed by Iredale<sup>23</sup> for the New Zealand species *Solemya parkinsonii* Gray.

<sup>18</sup> Dall, W. H., A Revision of the Solenomyacidae. *Nautilus*, Vol. 22, no. 1, May, 1908, pp. 1-2. See also, Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, pp. 361-366.

<sup>19</sup> *Solemya* sp., Clark & Woodford, *Univ. Calif. Publ. Bull. Dept. Geol. Sci.*, Vol. 17, no. 2, December 31, 1927, p. 85, pl. 14, fig. 1. Univ. Calif. Loc. 3162. North side of Deer Valley, north of Mt. Diablo, Mt. Diablo Quadrangle, California. Meganos formation; Eocene.

<sup>20</sup> *Solemya* (*Solemya*) *lomitensis* Olsson, *Bull. Amer. Paleol.*, Vol. 17, no. 63, June 5, 1931, p. 127 (31), pl. 15 (3), fig. 5. "Lomitos," Peru; Oligocene.

<sup>21</sup> Marwick, J., *Geol. Surv. New Zealand, Palaeo. Bull.* No. 13, 1931, p. 48, pl. 1, fig. 1.

<sup>22</sup> *Solemyarina* Iredale, *Rec. Austral. Mus.*, Vol. 18, no. 4, June 29, 1931, pp. 202, 231. "I introduce *Solemyarina* for these small species, designating *velesiana* as type." Sydney, Australia. ———Iredale, *Brit. Mus. (Nat. Hist.) Great Barrier Reef Exped. 1928-29. Sci. Repts.*, Vol. 5, no. 6, Moll. Pt. 1, 1939, p. 232. "Orthotype: *Solemya velesiana* Iredale."

<sup>23</sup> *Zesolemya* Iredale, *Brit. Mus. (Nat. Hist.) Great Barrier Reef Exped. 1928-29. Sci. Repts.*, Vol. 5, no. 6, Moll. pt. 1, 1939, p. 233.

KEY TO THE SPECIES OF *Solemya*.

- A. Ligament internal ..... (subgenus) *Petrasma*  
 a. Anterior end with 8 or 9 obscure rays.....*panamensis*  
 aa. Anterior end with fine radial striae only.....*valvula*
- B. Ligament external..... (subgenus) *Acharax*  
 a. Dorsal margin with a heavy callous.....*patagonica*  
 aa. Dorsal margin without accessory callous  
 b. Entire surface with subequally spaced radiating rays...*johnsoni*  
 bb. Surface with central area smooth or with obsolete rays  
 c. Posterior end evenly rounded.....*agassizii*  
 cc. Posterior end meeting hinge line and basal margin at rounded right angles.....*macroductyla*

Subgenus ***Acharax*** Dall.

*Acharax* Dall, *Nautilus*, Vol. 22, no. 1, May, 1908, p. 2. "Type *S. johnsoni* Dall." —Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 364.

*Type* (by original designation): *Solemya johnsoni* Dall.

Ligament opisthodontic, wholly external, visible internally only where it crosses the gap between the margins of the valves. Nymphs without props (Dall).

*Acharax* has been recorded from Oligocene to Recent.

***Solemya (Acharax) agassizii*** Dall.

*S[olemya]. agassizii* Dall, *Nautilus*, Vol. 22, no. 1, May, 1908, p. 2. "Off Tillamook Bay, Oregon, south to Aguja Point, Peru, in 1036-1800 fathoms."

*Solemya (Acharax) agassizii* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 365, pl. 16, fig. 10. U. S. S. *Albatross* station 3360, "Gulf of Panama, in 1672 fathoms, sand, bottom temperature 36°.4 F." Also at other stations from 1588, 1740, 1772, and 1793 fathoms; off Aguja Point, Peru, in 1036 fathoms; range; Gulf of California to off Aguja Point, Peru. —Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 37. Panama.—I. S. Oldroyd, *Stanford Univ., Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 9, pl. 40, fig. 11 (under subgenus *Acharax*). Original records cited.

*Acharax agassizii* Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 9. Tillamook, Oregon, to Point Aguja, Peru.

*Type Locality*: Gulf of Panama, in 1672 fathoms. Type No. 106,885 U. S. Nat. Mus.

*Range*: Off Tillamook, Oregon, to Aguja Point, Peru, in 1036 to 1800 fathoms.

The shell of *Solemya agassizii* is ornamented by about five or six anterior radial channels rather than from nine to twelve on *S. johnsoni*. *S. agassizii* differs from *S. macroductyla* Mabile & Rochebrune, a more southern species, in the presence of a smooth middle area on the valves, as well as the proportionately shorter posterior end, and much larger size. *S. grandis* Verrill & Bush<sup>24</sup>, an Atlantic species, has a shorter and wider shell.

*Solemya (Acharax) dalli* Clark<sup>25</sup> from the lower Miocene or upper Oligo-

<sup>24</sup> *Solemya grandis* Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, [No. 1139.], 1898, p. 885, pl. 86, figs. 1 and 2. "Two good specimens and some fragments, at four stations, between N. lat. 39° 58' 30", W. long. 70° 30', and N. lat. 37° 24', W. long. 74° 17', in 300 to 1,600 fathoms, 1880-1884."

<sup>25</sup> *Solemya dalli* Clark, *Univ. Calif. Publ. Bull. Dept. Geol. Sci.*, Vol. 15, no. 4, January 5, 1925, p. 73, pl. 8, fig. 2. L.S.J.U. Loc. NP. 120. "Shales outcropping in sea cliffs west of West Twin River for distance of ¾ mile, Twin, Washington." —Tegland, *Univ. Calif. Publ. Bull. Dept. Geol. Sci.*, Vol. 23, no. 3, October 11, 1933, p. 103, pl. 4, figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. Type locality. Also from Restoration Point, Blakeley formation, near Seattle, Washington. Upper Oligocene.

cene of Washington is a somewhat similar species and *Solemya tokunagai* Yokoyama<sup>26</sup> and *S. yessoensis* Kanehara<sup>27</sup>, from the Tertiary of Japan, are members of the same group.

*Solemya (Acharax) belenensis* Olsson<sup>28</sup> has been described from the Oligocene of Peru.

### ***Solemya (Acharax) johnsoni* Dall.**

*Solemya johnsoni* Dall, *Proc. U. S. Nat. Mus.*, Vol. 14, 1891, p. 189. "U. S. steamer *Albatross*, station 3010, off coast of Lower California, in 1,005 fathoms." —Dall, *Proc. U. S. Nat. Mus.*, Vol. 17, 1894, p. 712, pl. 25, fig. 1. Coast of Ecuador in 1,740 fathoms; Gulf of Panama, in 1,672-1,493 fathoms; Gulf of California in 1,000-1,588 fathoms; Straits of Fuca, in deep water. —Keep, West Amer. Shells (The Whitaker & Ray Co.,) San Francisco, 1904, p. 19, fig. 8. Deep water as far north as Puget Sound. —Dall, *Nautilus*, Vol. 22, no. 1, 1908, p. 2. Puget Sound to Panama Bay in 60 to 1740 fathoms. —Keep, West Coast Shells, (The Whitaker & Ray-Wiggin Co.) San Francisco, 1911, p. 24, fig. 10. Same locality as cited 1904. Edit. by Baily, 1935, p. 45, fig. 20 (as *Solemya (Acharax) johnsoni*). Oregon to Panama. —Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 37. Panama. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 9, pl. 14, fig. 1 (under subgenus *Acharax*). Type locality cited. Range: Oregon to Panama.

*Solenya* [Typ. error] *johnsoni* [Dall], Pilsbry, *Nautilus*, Vol. 5, no. 4, August, 1891, p. 47.

*Solenomya johnsoni* Dall, Rogers, The Shell Book, (Doubleday, Page & Co., Garden City, New York), 1913, p. 368. Puget Sound Southward.

*Acharax johnsonii* Dall, Dall, *U. S. Nat. Mus.*, *Bull.* 112, 1921, p. 9 (under genus *Solemya*). Oregon to Panama.

*Type Locality*: Off the coast of Lower California, in 1,005 fathoms.

*Range*: Puget Sound to Panama.

There are nine to twelve anterior radial channels on the shell of *Solemya johnsoni*, while there are only five or six such channels on the similar *S. agassizii*.

### ***Solemya (Acharax) macrodactyla* Mabilie & Rochebrune.**

*Solemya macrodactyla* Mabilie & Rochebrune, *Miss. Sci. Cap Horn*, Vol. 6, Zool., pt. 2, 1891, p. H109, pl. 8, fig. 4. "*Hab.* Baie Orange." —Dall, *Nautilus*, Vol. 22, no. 1, May, 1908, p. 2. —Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, 1908, p. 364. Orange Harbor, Patagonia, north to Chiloë Island, southwest Chile, in 20 to 369 fathoms.

*Type Locality*: Orange Harbor, Patagonia.

*Range*: Orange Harbor and north to Chiloë Island, southwest Chile, in 20 to 369 fathoms.

This southern species, *Solemya macrodactyla*, bears a resemblance to *Solemya agassizii* which occurs farther north, but the posterior end is less rounded than it is in that species. Mabilie & Rochebrune compared *S. mac-*

<sup>26</sup> *Solemya tokunagai* Yokoyama, *Jour. Coll. Sci. Imp. Univ. Tokyo*, Vol. 45, Article 5, March 21, 1925, p. 31, pl. 6, figs. 1, 2, 3. "Shiogu in Tatsuta; Tsuchibashi in Kadōno; Enamura Quarry." Pliocene. —Kanehara, *Jap. Jour. Geol. & Geogr.*, Vol. 14, nos. 3 & 4, 1937, p. 156, pl. 15, figs. 10, 11 (as *Solemya (Acharax) tokunagai*). "Near Mōrae, Atsuta-gun, Ishikari." Oiwake Series; upper Miocene to Pliocene.

<sup>27</sup> *Solemya (Acharax) yessoensis* Kanehara, *Jap. Jour. Geol. & Geogr.*, Vol. 14, nos. 3 & 4, October, 1937, p. 155, pl. 15, fig. 12. "Near Mōrai, Atsuta-gun, Ishikari." Oiwake Series; upper Miocene to Pliocene.

<sup>28</sup> *Solemya (Acharax) belenensis* Olsson, *Bull. Amer. Paleol.*, Vol. 17, no. 63, June 5, 1931, p. 127 (31), pl. 15 (3), fig. 7. "Heath formation, Lobos, Pajarabobo." Peru; Oligocene.



*rodactyla* to *S. borealis* Totten which occurs from Halifax, Nova Scotia, to Connecticut, and to *S. parkinsonii* Gray<sup>29</sup> of New Zealand. Dall has pointed out that *Solemya macrodactyla* may ultimately be relegated to the synonymy of *S. patagonica* E. A. Smith.

### ***Solemya (Acharax) patagonica* E. A. Smith.**

*Solemya patagonica* E. A. Smith, Sci. Res. Voy. Challenger, Zool., Vol. 13, 1885, pp. 24, 208, pl. 11, figs. 1, 1a. "Habitat. ————Station 311, off west coast of South Patagonia, in 245 fathoms." ————Dall, *Nautilus*, Vol. 22, no. 1, May, 1908, p. 2. ————Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 364. West coast of Patagonia.

*Type Locality*: Off west coast of Chile, in 245 fathoms.

*Range*: West coast of Chile.

At the time of description of *Solemya patagonica*, E. A. Smith compared the species to *S. parkinsonii* Gray of New Zealand. Dall considered it likely that *S. macrodactyla* Mabilie & Rochebrune might be relegated to the synonymy of *S. patagonica*, but stated that the type of *S. patagonica* appeared to be abnormally callous dorsally.

E. A. Smith (*Ann. & Mag. Nat. Hist.*, Ser. 7, vol. 18, October, 1906, p. 253) has cited *S. patagonica* from off India, and Melvill & Standen (*Proc. Zool. Soc. London*, November 13, 1906, p. 793) have cited it from the Gulf of Oman in the Arabian Sea. We have not seen specimens from that region.

### Subgenus ***Petrasma*** Dall.

*Petrasma* Dall, *Nautilus*, Vol. 22, no. 1, May, 1908, p. 2. "Type *S. borealis* Totten." ————Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 363.

*Type* (by original designation): *Solemya borealis* Totten. [*Amer. Jour. Sci.*, Ser. 2, Vol. 26, July, 1834, p. 366, pl. [unnumbered], fig. 1, h, i. "Inhabits the coast of Rhode Island." Also illustrated by M. Smith, East Coast Mar. Shells (Edwards Bros., Ann Arbor, Michigan), 1937, p. 25, fig. 29a. Nova Scotia to Connecticut].

Ligament internal but not exposed internally in front of the chondrophore.

### ***Solemya (Petrasma) panamensis*** Dall.

*S[olemya]. panamensis* Dall, *Nautilus*, Vol. 22, no. 1, May, 1908, p. 2. "extends from off Santa Barbara, Cal., to Panama Bay."

*Solemya (Petrasma) panamensis* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 366. "U. S. S. 'Albatross,' station 2799, Panama Bay, in 29½ fathoms, mud." Also off Santa Barbara, California, in 68 fathoms.

*Solemya panamensis* Dall, *Zetek, Rev. Nueva*, Nos. 1 & 2, 1918, p. 37. Panama. ————I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 10, pl. 9, fig. 4. Original record cited. ————Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, 1932, p. 141. "On mud flats at extreme tide, rare. La Paz." ————Lowe, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, no. 6, 1935, p. 27. Punta Penasco, Sonora, Mexico, dredged in 10 fathoms. ————Strong, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 23, no. 12, 1937, p. 192. San Martin Island, Lower California, Mexico.

<sup>29</sup> *Solemya parkinsonii* Gray, *Voy. Erebus & Terror*, 1874, p. 6, pl. 3, fig. 1 ————Suter, *Man. New Zealand Moll.* (Wellington, New Zealand), 1913, p. 830, pl. 58, fig. 1. Throughout New Zealand, in mud about 6 inches below the surface; Kermadec Islands; Milford Sound, in 100-120 fathoms.

*Petrasma panamensis* Dall, Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 9. Santa Barbara, California, to Panama.

*Type Locality*: Panama Bay, 29½ fathoms. Type No. 110,678 U. S. Nat. Mus.

*Range*: Santa Barbara, California, to Panama.

This is more expanded in front and less sharply truncate in front than *S. agassizii* of the same length, and they may be separated at once by the difference in the hinges. *S. valvulus* Carpenter is a much smaller species and has no anterior prop to the chondrophore (Dall).

### ***Solemya (Petrasma) valvulus* Carpenter.**

*Solemya valvulus* Carpenter, *Ann. & Mag. Nat. Hist.*, Ser. 3, Vol. 13, April, 1864, p. 311. Cape St. Lucas. Reprint in *Smithson. Misc. Coll.*, No. 252, 1872, p. 210. —Carpenter, *Rept. Brit. Assoc. Adv. Sci.* for 1863 (issued August, 1864), p. 618. Reprint in *Smithson. Misc. Coll.*, No. 252, 1872, p. 104. —Dall, *Nautilus*, Vol. 22, no. 1, May, 1908, p. 2. San Pedro, California, to the Gulf of California. —Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 364. San Pedro, California, to the Gulf of California. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 11, pl. 40, fig. 10 (under subgenus *Petrasma*). Type locality cited. Range: San Pedro, California, to the Gulf of California. —Lowe, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, no. 6, 1935, p. 27. Punta Penasco, Sonora, Mexico, dredged in 10 fathoms:

*Solemya (Petrasma) valvulus* Carpenter, Lamy, *Journ. de Conchyl.*, Vol. 57, no. 3, 1909, p. 208. Gulf of California.

*Petrasma valvulus* Carpenter, Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 9. San Pedro, California, to the Gulf of California.

*Type Locality*: Cape San Lucas, Lower California.

*Range*: San Pedro, California, to Punta Penasco, Sonora, Mexico.

The shell of *Solemya valvulus* is small, thin, transparent and attains a length of about 20 mm. It is ornamented by radial slender brownish lines which are finely striate posteriorly, distantly spaced on the medial portion of the shell, and short, broad, and bifurcate anteriorly. The chondrophore is without props.

## Superfamily Nuculacea.

### Family Nuculidae.

The family Nuculidae is an ancient one and has representatives in the Paleozoic. *Praenucula* Pfab<sup>30</sup> assigned to this family has been described from the Silurian of Bohemia. In the Nuculidae the pallial impression is entire, due to the lack of development of siphons. The shells are entirely closed, not gaping, and the inner shell-layer is pearly. The family occurs in both shallow and deep water. A few occur in tropical waters but most of the species occur in temperate and boreal waters.

Two papers by Schenck<sup>31</sup> on the classification of nuclid pelecypods may be consulted regarding the nomenclature of members of this family. Dr. Schenck has kindly examined a number of specimens of *Nucula* and *Nuculana* in the present collection and has furnished us notes on certain of the species.

<sup>30</sup>*Praenucula* Pfab, *Palaeontogr.*, Bd. 80, Abt. A, Lief. 4-6, April, 1934, p. 234. "Typus des Genus: *P. dispar expansa* n. var." p. 235, pl. 3, figs. 10, 11, 15a, 15b. Osek.

<sup>31</sup>Schenck, H. G. Classification of Nuclid Pelecypods. *Bull. Mus. Roy. d'Hist. Nat. Belgique*, Vol. 10, no. 20, June, 1934, 78 pp., 5 pls. —Schenck, H. G. Revised Nomenclature for some Nuclid Pelecypods. *Jour. Paleo.*, Vol. 13, no. 1, pp. 21-41, 4 pls., January, 1939.

Genus *Nucula* Lamarck.

*Nucula* Lamarck, *Mem. Soc. Hist. Nat. Paris*, Vol. 1, 1799, p. 87. Sole species: *Arca nucleus* Linnaeus. ————Schenck, *Bull. Mus. Roy. d'Hist. Nat. Belg.*, Vol. 10, no. 20, 1934, p. 18, pl. 1, fig. 8; pl. 3, fig. 2; pl. 4, figs. 4, 4a, 4b; pl. 5, figs. 1, 1a. "(Type by monotypy: *Arca nucleus* Linné.)"

*Type* (by monotypy): *Arca nucleus* Linnaeus. [*Syst. Nat.*, Ed. 10, 1758, p. 695. "*Habitat in Europa.*" Illustrated by Schenck, *Bull. Mus. Roy. d'Hist. Nat. Belg.*, Vol. 10, no. 20, 1934, p. 18, pl. 1, fig. 8; pl. 3, fig. 2; pl. 4, figs. 4, 4a, 4b; pl. 5, figs. 1, 1a. ————Schenck, *Proc. Malacol. Soc. London*, Vol. 21, pt. 4, March, 1935, fig. 1 (p. 260)].

Shell closed, not gaping; profile ovate-trigonal; a "pouting" of the escutcheonal area, which the radial ribs do not cross; beaks opisthogyrate, appressed; prodissoconch unornamented; radial ribs faint, low, wide and flat, often difficult to see on the middle part of the shell, but they are more distinct near the ventral margin where they form the "pectinate margin"; interspaces narrow, about one-tenth the width of the ribs; interior nacreous; pallial line simple; two subequal adductor muscle scars and additional muscle scars; longer (anterior) row of teeth arched, with  $16 \pm$  to  $24 \pm$  teeth; the shorter (posterior) row straight with  $7 \pm$  to  $11 \pm$ ; axis of chondophore forms an arc of a circle of which the arcuate dorsal margin is a part (Schenck).

KEY TO THE SPECIES OF *Nucula*<sup>32</sup>.

- A. Outer surface smooth
  - a. Periostracum olive
    - b. Periostracum dark olive
      - c. Length less than 10 mm
        - d. Shape subcordate, umbos weak, length 8 mm., height 4 mm. .... *tenuis*
        - dd. Shape subtrigonal, umbos prominent, length 6 mm., height 5 mm. .... *linkei*
      - cc. Length over 20 mm., solid, thick..... *panamina*
    - bb. Periostracum pale olive
      - e. Length less than 10 mm., shape, ovate..... *colombiana*
      - ee. Length 14-21 mm. .... *savatieri*
  - aa. Periostracum greenish or black
    - f. Periostracum greenish
      - g. Anterior hinge teeth 8, posterior 18..... *cardava*
      - gg. Anterior hinge teeth 5, posterior 11..... *grayi*
    - ff. Periostracum nearly black ..... *agujana*
- B. Outer surface sculptured
  - a. Concentric sculpture only
    - b. Length less than 10 mm..... *pisum*
    - bb. Length over 20 mm..... *tanneri*
  - aa. Radial sculpture present
    - c. Radial sculpture faint
      - d. Length less than 5 mm.
      - e. Anterior teeth less than 15

<sup>32</sup> In the case of species which are not illustrated and which we have not seen, the key is based upon descriptions.

KEY TO THE SPECIES OF *Nucula* (continued):

- f. Sculpture definitely reticulate, concentric strong, anterior teeth 9, posterior 5 ..... *schencki*
- ff. Sculpture not reticulate, concentric weak, anterior teeth 10, posterior 6 ..... *chrysocoma*
- ee. Anterior teeth 17, posterior 9 ..... *paytensis*
- dd. Length over 10 mm.
  - g. Anterior hinge teeth 6, posterior 10 ..... *taeniolata*
  - gg. Anterior hinge teeth 7, posterior 15-17 ..... *pigafettae*
- cc. Radial sculpture strong
  - h. Length less than 10 mm.
    - i. Concentric sculpture heavier, regular rugae ..... *exigua*
    - ii. Concentric sculpture fine, irregular ..... *declivis*
  - hh. Length over 30 mm. .... *iphigenia*

***Nucula (Nucula) declivis* Hinds.**

Plate I, Figures 1, 2, 3, 6, 7.

*Nucula declivis* Hinds, *Proc. Zool. Soc. London*, December, 1843, p. 98. "Hab. ....?" —Hinds, *Zool. Voy. Sulphur, Moll. Pt. 3, 1844* (January, 1845, on cover of Pt. 3), p. 63, pl. 18, fig. 8. "Inhab. ....?" —Hanley, *Thes. Conch.*, Vol. 3, 1860, *Nucula*, p. 154, pl. 230 (*Nuculidae*, pl. 5), fig. 147. "Hab. ....?" —Sowerby, *Conch. Icon.*, Vol. 18, *Nucula*, October, 1870, sp. 31, pl. 4, fig. 31. "Hab. ....?" —Dall, *Proc. U. S. Nat. Mus.*, Vol. 31, 1909, p. 250. "Panama to Magellan Straits." —Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 37. Panama. —Lowe, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, no. 6, 1935, p. 27. Punta Penasco, Sonora, Mexico. —Strong & Hertlein, *Allan Hancock Pacific Exped. (Univ. South. Calif.)*, Vol. 2, no. 12, 1939, p. 183. Bahia Honda, and off Taboga Island, Panama.

*Type Locality*: Original locality not known. Type locality here designated as off Taboga Island, Panama, in 3-9 fathoms.

*Range*: Punta Penasco, Sonora, Mexico, to Panama. [?] Panama to Magellan Straits (Dall).

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (145-D-1,-3). 4-15 fathoms, sand; Manzanillo Bay (184-D-2). 30 fathoms, gravelly sand bottom; Nicaragua: Corinto (200-D-19 and beach). 12-13 fathoms, mangrove leaves; Costa Rica: (203-D-1,-3). 12-15 fathoms, sand and shelly mud bottom.

This species has a small, smooth, oblique shell ornamented by very fine radial striations. In the original description it is stated that the ventral margin is crenulate, and that the species is "a still more oblique shell than *N. pisum*, to which it is closely allied." From the original illustrations alone it would be difficult to separate *N. declivis* from *N. pisum* Sowerby although Sowerby's species appears to be less oblique. *N. pisum* was originally described from Valparaiso, Chile. Hanley and Dall have considered *N. semiornata* d'Orbigny<sup>33</sup> to be synonymous with *N. pisum*. Specimens of *N. declivis* from the Gulf of California resemble, in general features, *N. crenulata* Adams<sup>34</sup> from Florida.

<sup>33</sup> *Nucula semi-ornata* d'Orbigny, *Voy. Amér. Mérid.*, Vol. 5, 1846, p. 624, pl. 84, figs. 27, 28, 29. "Nous l'avons recueillie dans la baie de San Blas, au nord de la Patagonie, où elle vit au niveau des plus basses marées. Elle y est très-rare. M. Darwin l'a reconstruite fossile à la baie Blanche."

<sup>34</sup> *Nucula crenulata* A. Adams, *Proc. Zool. Soc. London*, 1856, p. 52. "Hab. Guadeloupe Mus. Cuming." —Hanley *Thes. Conch.*, Vol. 3, 1860, p. 154, pl. 229, (*Nuculidae*, pl. 4), figs. 134, 135. "Guadeloupe." —Sowerby, *Conch. Icon.*, Vol. 18, *Nucula*, October, 1870, sp. 25, pl. 4, fig. 25. "Hab. Guadeloupe."

***Nucula (Nucula) exigua* Sowerby.**

Plate I, Figures 4, 5.

*Nucula exigua* Sowerby, *Proc. Zool. Soc. London* for 1832 (issued March 13, 1833), p. 198. "Hab. ad Columbianam Occidentalem (Bay of Caraccas)." [Ecuador Lat. 0° 35'S.] "A single specimen found in sandy mud at nine fathoms depth."

—Sowerby, *Conch. Illustr.*, 1833, *Nuculae*, p. 6, pl. 16, figs. 24, 24\*. "Bay of Caraccas." —Müller, *Synop. Test. Viv.*, 1836, p. 192. Type locality cited. —Hanley, *Cat. Rec. Bivalve Shells*, p. 172, 1843, p. 376, ?1856, *Suppl. pl. 20*, fig. 13, 1856. W. Colombia. —d'Orbigny, *Voy. Amér. Mérid.*, Vol. 5, 1846, p. 625. Original locality cited. —C. B. Adams, *Ann. Lyceum Nat. Hist. New York*, Vol. 5, 1852, p. 479. Panama. Also earlier records cited. —Carpenter, *Cat. Mazatlan Shells*, February, 1856, p. 145. (as *Nucula ? exigua*). Mazatlan, Mexico. Also earlier records cited. —Carpenter, *Rept. Brit. Assoc. Adv. Sci.* for 1856 (issued 1857), pp. 249, 277, 311. Gulf of California; Central America; Panama; Bay of Caraccas, Ecuador. —Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 154, pl. 229, (*Nuculidae*, pl. 4), fig. 136. "Bay of Caracas, W. Columbia." —Carpenter, *Proc. Zool. Soc. London*, 1863, p. 364. Reprint in *Smithson. Misc. Coll.*, No. 252, 18i2, p. 200. C. B. Adams' record cited. —Sowerby, *Conch. Icon.*, Vol. 18, *Nucula*, October, 1870, sp. 26, pl. 4, fig. 26. "Hab. West Columbia." —Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, 1908, p. 370. Bay of Panama (Cuming); off Acapulco, Mexico, in 660 fathoms; near the Galapagos Islands, in 812 fathoms; off Aguja Point, Peru, in 1036 fathoms; west coast of Patagonia, in 122 and 194 fathoms. —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 250. Acapulco, Mexico, to Ecuador and to the Magellanic region. —Zetek, *Rev. Nueva*, Nos. 1 and 2, 1918, p. 51. Zoogeographical province of Panama. —Olsson, *Nautilus*, Vol. 37, no. 4, 1924, p. 126. Salinas, Ecuador. Common. —E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1, no. 4, 1936, p. 112. Magdalena Bay, Lower California, Pleistocene.

*Nucula (Nucula) exigua* Sowerby, Schenck, *Jour. Paleo.*, Vol. 13, no. 1, 1939, p. 36, pl. 6, figs. 1-8, 11. Type loc. cited. Also western North America.

*Type Locality*: Bay of Caraccas, Ecuador, in 9 fathoms, in sandy mud. Type in Brit. Mus. (Nat. Hist.).

*Range*: San Bartolome Bay [Turtle Bay], Lower California, and Gulf of California to Ecuador. [?] Magellanic region (Dall).

*Collecting Station*: Nicaragua: Corinto (200-D-19). 12-13 fathoms, mangrove leaves.

The shell of *Nucula exigua* is ornamented by concentric and radial ornamentation but the concentric is much the stronger. It is a small shell averaging not over 5 mm. in length. A strongly projecting lunular area just under the beaks appears to be a characteristic feature of the species. These differences are well shown on photographs of the type of *N. exigua* shown to us by H. G. Schenck.

Some authors have considered *N. exigua* to be identical with *N. suprastrata* Carpenter (in Arnold)<sup>35</sup> but Schenck has given reasons for considering them to be distinct species. The radial ribbing on *N. suprastrata* is not well developed and usually is present only near the ventral margin. The lunule and escutcheon is more deeply impressed on *N. suprastrata* and it is a larger shell averaging 5.5 to 6 mm. in length. *Nucula cahuitensis* Olsson<sup>36</sup> from the Miocene of Costa Rica was compared to *N. exigua* by Olsson.

*Nucula paytensis* A. Adams, bears considerable similarity to *N. exigua*. Photographs of the type of the species described by Adams show a more rounded outline and broader projecting lunular area but we are not certain whether these differences are constant characters which can be used to separate the two species.

<sup>35</sup> *Nucula (Nucula) suprastrata* Carpenter in Arnold, *Mem. Calif. Acad. Sci.*, Vol. 3, 1903, p. 96, pl. 18, fig. 6. "Upper San Pedro series, Los Cerritos" Upper Pleistocene. Also at Spanish Bight, San Diego, California, upper Pleistocene. Rare in lower San Pedro of Deadman Island, lower Pleistocene, and in the upper San Pedro Series of San Pedro, California, upper Pleistocene. —Schenck, *Jour. Paleo.*, Vol. 13, no. 1, 1939, p. 36, pl. 6, figs. 9, 10, 12, 13. Various localities in the Pleistocene of southern California.

<sup>36</sup> *Nucula cahuitensis* Olsson, *Bull. Amer. Paleo.*, Vol. 9, Bull. No. 39, June 21, 1922, p. 343 (171), pl. 21 (18), figs. 21-24. "Gatun Stage: Zone G, Saury Creek," Costa Rica. Miocene.

Subgenus **Ennucula** Iredale.

*Ennucula* Iredale, *Rec. Australian Mus.*, Vol. 18, no. 4, June 29, 1931, pp. 202, 231. "Type *Nucula obliqua* Lamareck. —Schenck, *Bull. Mus. Roy. d'Hist. Nat. Belg.*, Vol. 10, no. 20, 1934, p. 37, pl. 3, figs. 4, 4a, 4b; pl. 4, figs. 3, 3a, 3b. Type: *Nucula obliqua* Lamareck. —Cotton & Godfrey, *Moll. South Australia*, Pt. 1. Handbook of Flora and Fauna of South Australia, issued by South Australian Branch of Brit. Sci. Guild. Adelaide, 1938, p. 40. "Genotype —*E. obliqua* Lamareck." —Iredale, *Brit. Mus. (Nat. Hist.) Great Barrier Reef Exped. 1928-29 Sci. Repts.* Vol. 5, no. 6, *Moll.*, pt. 1, 1939, p. 235. Orthotype: *Nucula obliqua* Lamareck.

*Type* (by original designation): *Nucula obliqua* Lamareck. [Anim. s. Vert., Vol. 6, 1819, p. 59. "Habite les mers australes, au cap aux Huitres." —Illustrated by Schenck, *Bull. Mus. Roy. d'Hist. Nat. Belg.*, Vol. 10, no. 20, 1934, p. 37, pl. 3, figs. 4, 4a, 4b; pl. 4, figs. 3, 3a, 3b. "Cap aux Huitres, Nouvelle Hollande."]

The type species of *Nucula* is *nucleus* Linné, a European species which differs appreciably from antipodean shells so classed, the latter having a notably oblique chondrophore, above which the teeth become much smaller, and the angle of opposition of the two rows of teeth is scarcely marked; further, the edge of the European shell is strongly denticulate, whereas ours is practically smooth (Iredale).

***Nucula (Ennucula) tenuis* Montagu.**

*Arca tenuis* Montagu, *Test. Brit.*, Suppl., 1808, p. 56, pl. 29, fig. 1. "on the shore near Dunbar," England.

*Nucula tenuis* Montagu, Forbes & Hanley, *Hist. Brit. Moll.*, Vol. 2, 1853, p. 223, pl. 47, fig. 6; and (animal) pl. P, fig. 5. England and North Atlantic, Massachusetts. Also Pliocene. —Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 161, pl. 229 (*Nuculidae*, pl. 4), figs. 140, 141. Britain, W. Europe. —Sowerby, *Conch. Icon.*, Vol. 18, *Nucula*, October, 1870, sp. 20, pl. 3, fig. 20. "Hab. Britain, Europe." —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, no. 1, 1924, p. 13, pl. 5, fig. 12; pl. 37, fig. 4. Point Barrow, Alaska, to Coronado Islands, California. Circumboreal. Pliocene at San Pedro and San Diego, California. —Antevs, *För. Geol. Fören. i Stockholm*, Bd. 50, Heft 4, 1928, p. 493.

*Nucula (Nucula) tenuis* Montagu, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 111. Earlier records cited. "Miocene" [Pliocene] of St. Paul Island, and Nushagak Island, Alaska (Dall), and Recent. Circumboreal.

*Nucula (Ennucula) tenuis* Montagu, Schenck, *Jour. Paleo.*, Vol. 13, no. 1, January, 1939, p. 33, pl. 8, figs. 1-4, 9, 12, 14, 15. Earlier records cited.

Not *Pronucula tenuis* Powell, *Rec. Canterbury Mus.*, Vol. 3, no. 2, December 14, 1927, p. 119, pl. 22, figs. 1, 2. Southwest of Otago, New Zealand, in 100 fathoms.

*Type Locality*: Near Dunbar, England, on shore.

*Range*: Northern Europe. Northeastern North America. Circumboreal. Point Barrow, Alaska, to Cedros Island, Lower California.

*Collecting Station*: Mexico: East of Cedros Island (126-D-12). 45 fathoms, crushed shell and mud bottom.

One specimen of *Nucula tenuis* was dredged in Lat. 28° 20' N., Long. 115° 10' 30" W., one mile east of Cedros Island, Lower California. Heath<sup>37</sup> has recently studied the soft parts of this species.

This appears to be a wide-ranging form. According to Schenck some of the specimens dredged off British Columbia agree exactly with specimens of the species from the North Sea. Schenck has placed *Nucula tenuis* in the subgenus *Ennucula* Iredale. The bathymetric range of the species given by Antevs is 2 to 1,200 meters.

<sup>37</sup> Heath, H., *Mem. Mus. Roy. d'Hist. Nat. Belgique*, Ser. 2, Fasc. 10, 1937, pp. 4, 9, etc., pl. 3, figs. 19, 20, 21, 22, 26; pl. 4, figs. 31, 33, 34; pl. 5, fig. 44; pl. 9, fig. 81. Behring Sea, in 36 fathoms.

***Nucula (Ennucula) cardara* Dall.**

*Nucula cardara* Dall, *Proc. U. S. Nat. Mus.*, Vol. 52, December 27, 1916, p. 394. "Station 5673, in 1090 fathoms, mud, off San Diego, California." —Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 10. Monterey, California, to Lower California, in deep water. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 12. Type locality and range same as cited by Dall. —Keen, Check List West North Amer. Mar. Moll. (Stanford Univ. Press), 1937, p. 23. Lat. 30°-37° N.

*Nucula (Ennucula) cardara* Dall, Schenck, *Jour. Paleo.*, Vol. 13, no. 1, January, 1939, p. 34, pl. 5, figs. 12, 14, 18, 21. Type locality cited.

*Type Locality*: Off San Diego, California, in 1090 fathoms, mud. Type No. 265905 U. S. Nat. Mus.

*Range*: Monterey, California, to Lat. 30° N., Lower California, in deep water.

Shell elongate-ovate, thin, polished, light olive green in color; hinge with 8 anterior and 18 posterior teeth; margins of valves smooth. Length, 16 mm.; height, 11.5 mm.; diameter, 8 mm.

***Nucula (Ennucula?) linki* Dall.**

*Nucula linki* Dall, *Proc. U. S. Nat. Mus.*, Vol. 52, December 27, 1916, p. 394. "Station 3034, 24 fathoms, mud; off Point Fermin, Lower California." —Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 10. Queen Charlotte Sound to Guaymas, Mexico. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 12. Type locality and range same as cited by Dall. —Keen, Check List West North Amer. Mar. Moll. (Stanford Univ. Press), 1937, p. 23, Lat. 23°-55° N.

*Nucula (Ennucula?) linki* Dall, Schenck, *Jour. Paleo.*, Vol. 13, no. 1, January, 1939, p. 33, pl. 5, figs. 2, 6, 11, 15. Type locality cited.

*Type Locality*: Off Point Fermin, California, in 24 fathoms, mud. [According to Schenck, not from off Point Fermin, Lower California, as originally cited by Dall]. Type No. 107649 U. S. Nat. Mus.

*Range*: Queen Charlotte Sound, British Columbia, to Guaymas, Sonora, Mexico.

Shell small, inflated, very inequilateral, subtriangular and of a dark olive color; hinge with six anterior and eleven posterior teeth; valve margins entire. Length, 6 mm.; height, 5 mm.; diameter, 3.6 mm.

**Subgenus *Nuculopsis* Woodring.**

*Nuculopsis* Woodring, *Carnegie Inst. Washington, Publ.* No. 366, May, 1925, p. 14. [Cited in caption only. ? Typ. error.].

*Nuculopsis* Woodring, *Carnegie Inst. Washington, Publ.* No. 366, May, 1925, p. 14. "Type. —*Nucula (Nuculopsis) hilli* new species." —Schenck, *Bull. Mus. Roy. d'Hist. Nat. Belg.*, Vol. 10, no. 20, June, 1934, p. 33. Type: *Nucula hilli* Woodring.

Not *Nuculopsis* Girty, *Ann. New York Acad. Sci.*, Vol. 21, 1911, p. 133. "Type species, *Nucula ventricosa* Hall." Pennsylvanian series.

Not *Nuculopsis* Rollier, *Abh. Schweiz. Paläont. Gesell.*, Vol. 38, Part 2, 1912, p. 64. Renamed *Isoleda* by Rollier, *Rev. Crit. Paléozool.*, Vol. 27, no. 1, January, 1923, p. 67. "(G.-T. *Nuc. Palmae* Sow.)" Jurassic.

*Type* (by original designation): *Nucula (Nuculopsis) hilli* Woodring, *Carnegie Inst. Washington, Publ.* No. 366, May, 1925, p. 14, pl. 1, figs. 2 and 3. Bowden, Jamaica, Miocene.

Shell medium-sized, subelliptical, inequilateral; sculpture consisting of strong concentric rugae; chondrophore long, narrow, oblique, deeply excavated; anterior series of teeth more than twice as long as posterior series;

anterior teeth reduced in size toward chondrophore, posterior teeth not reduced; interior of valve subnacreous; lower inner margin of valve smooth (Woodring).

At the present time the subgenus "*Nuculopsis*" is represented by the type species *Nucula hilli*, in the Miocene of Bowden, Jamaica, and by one species, *N. schencki*, in the Recent fauna of western Mexico.

At the time of description of this subgenus Woodring spelled it *Nuculopsis* in the caption but following that on the same page it is consistently spelled "*Nuculopsis*." There is a prior *Nuculopsis* described by Girty and also one by Rollier. Dr. Schenck is working on the family Nuculidae and is of the opinion that *Nuculopsis* may be regarded as a typographical error for *Nuculopsis*. We have used the original spelling used by Woodring but the name may not be valid, and if not it will be rectified in Schenck's forthcoming work on the Nuculidae.

***Nucula (Nuculopsis) schencki* Hertlein & Strong, sp. nov.**

Plate I, Figures 8, 9, 10.

Shell thin, polished; rather compressed; beaks small; dorsal margin anterior to beaks elevated and broadly rounded; anterior end more acutely rounded; ventral margin and posterior end broadly rounded; sculpture consists of rather closely spaced concentric ribs crossed by faint radiating striae which are weaker on the umbos; lunular area not depressed, area of escauchon marked only by a very short thin line. Length 2.0 mm., height 1.7 mm., thickness both valves 1.0 mm.

Interior of paratypes reveals a smooth, glossy surface with faint crenulations along the ventral margin corresponding to the exterior striae; chondrophore relatively large, deeply set, elongate, subtriangular, the axis oblique; teeth well developed, about 9 in the anterior series and 5 in the posterior series.

Holotype, from Sta. 195-D-9, dredged in 7 fathoms (12.6 meters) Lat. 15° 44' 28" N., Long. 96° 07' 51" W., Port Guatulco, Mexico, gray sand and crushed shell bottom.

*Nucula schencki* sp. nov. resembles *Nucula* ("*Nuculopsis*") *hilli* Woodring<sup>38</sup> described from the Miocene of Jamaica more closely than any Recent west American shell. The more elongate shape, lack of radial striae exteriorly, noncrenulate lower interior margin and greater number of teeth on the Jamaican shell easily separate it from the present species. We have had available photographs of the type specimen of *Nucula hilli* for comparison with our new species. The photographs were furnished by Dr. H. G. Schenck who received them from Dr. Paul Bartsch of the U. S. National Museum.

The new species has been referred to the subgenus *Nuculopsis* because it resembles that group in most of its general characters although it does have very faint crenulations on the interior of the ventral margins.

This species is named for Dr. Hubert G. Schenck of Stanford University in recognition of his work on the Nuculidae.

The subgeneric position of the following species of *Nucula* is uncertain.

***Nucula agujana* Dall.**

*Nucula agujana* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 370, pl. 10, figs. 6, 7. U. S. S. Albatross station 4654, "twenty-four miles N. 68° W. from Aguja Point, Peru, in 1036 fathoms, mud, bottom temperature 37°.3 F."

<sup>38</sup> *Nucula (Nuculopsis) hilli* Woodring, *Carnegie Inst. Washington, Publ. No. 366*, May, 1925, p. 14, pl. 1, figs. 2 and 3. Bowden, Jamaica, Miocene.



*Type Locality*: 24 miles northwest of Aguja Point, Peru, in 1,036 fathoms, mud. Type No. 110,571 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell small, triangular, inequilateral, polished, nearly black with paler olivaceous umbos; hinge with 15 anterior and 9 posterior teeth; margins of the valves smooth. Length, 11 mm.; height, 8 mm.; diameter, 5.75 mm.

### ***Nucula chrysocoma* Dall.**

*Nucula chrysocoma* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 370, pl. 18, figs. 3 and 4. U. S. S. *Albatross* Station 4656, "off the coast of Peru in S. Lat. 6°55' and W. Long. 83°34', in 2,222 fathoms, green mud, bottom temperature 35°.2 F." Also off Manta, Ecuador, in 401 fathoms, and off Acapulco, Mexico, in 660 fathoms.

*Type Locality*: Off the coast of Peru, Lat. 6° 55' S., Long. 83° 34' W., in 2,222 fathoms, green mud. Type No. 110,572 U. S. Nat. Mus.

*Range*: Off Acapulco, Mexico, to Peru, in deep water.

Shell small, plump, solid, subtriangular, polished, and of a light yellowish-olive color; sculpture of irregularly spaced impressed concentric lines and fine slightly raised, close-set radial lines; hinge with 10 anterior and 6 posterior teeth; margins of valves entire. Length, 5.0 mm.; height, 4.5 mm.; diameter 3.0 mm.

### ***Nucula colombiana* Dall.**

*Nucula colombiana* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 371. "West coast of Colombia, in Panama Bay at station 2799, in 29½ fathoms." Also in Panama Bay, in 51 fathoms; off Manta, Ecuador, in 401 fathoms; southern Chile, in 122 and in 194 fathoms; off west coast of Patagonia, Lat. 51° 12' S., in 258 fathoms. —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 250. Panama to Patagonia.

*Type Locality*: West coast of Colombia, in Panama Bay, in 29½ fathoms. Type No. 110,686 U. S. Nat. Mus.

*Range*: Panama to west coast of Patagonia in Lat. 51° 12' S.

Shell small, very inequilateral, ovate, white with a pale olive perios-tracum, smooth and brilliantly polished; hinge with 14 anterior and 7 posterior teeth; margins of valves smooth. Length, 4.5 mm.; height, 3.0 mm.; maximum diameter, 2.2 mm.

### ***Nucula grayi* d'Orbigny.**

*Nucula obliqua* Lamarck, Sowerby, *Conch. Illustr.*, *Nuculae*, 1833, p. 5, pl. 16, fig. 21. "Valparaiso, Mr. Cuming." —Hanley, *Cat. Recent Bivalve Shells*, p. 171, 1843, p. 376, 1856?, *Suppl. pl. 20*, fig. 9, 1856. "Valparaiso, South Seas."

Not *Nucula obliqua* Lamarck, *Hist. Nat. Anim. s. Vert.*, Vol. 6, 1819, p. 59. "Habite les mers australes, au cap aux Huîtres."

*Nucula grayi* d'Orbigny, *Voy. Amér. Mérid.*, Vol. 5, 1846, p. 625. "Cette espèce, la plus grande que nous connaissions dans les mers du Chili, a été recueillie par nous près de Valparaiso, où elle est rare." New name for "*Nucula obliqua*, Gray (non Lamarck)." —Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 157, pl. 229 (*Nuculidae*, pl. 4), fig. 126. Chili. —Hupé, *Hist. de Chile, Zool.*, Vol. 8, 1854, p. 304. —Sowerby, *Conch. Icon.*, Vol. 18, *Nucula*, October, 1870, sp. 13, pl. 2, fig. 13. "Hab. New Zealand." [Not New Zealand]. —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 250. Valparaiso, Chile.

*Type Locality*: Valparaiso, Chile.

*Range*: Known only from the vicinity of the type locality.

Shell thin, oval, much longer than broad, with a polished greenish-olive periostracum; margins entire.

### ***Nucula iphigenia* Dall.**

*Nucula iphigenia* Dall, *Proc. U. S. Nat. Mus.*, Vol. 18, April 23, 1896, p. 15. "U. S. Fish Commission station 3396, in 259 fathoms, Gulf of Panama; temperature, 47.4°F." —Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 369, pl. 7, figs. 1 and 4. "Gulf of Panama, in 259 fathoms, hard bottom; temperature, 47.4° F."

*Type Locality*: Gulf of Panama, in 259 fathoms, hard bottom. Type No. 122,895 U. S. Nat. Mus.

*Range*: Known only from the type locality.

This fine shell is one of the largest known *nuculas*, and peculiar from its elongated shape and posterior attenuation. The periostracum seems to have been thin, dull, and yellowish (Dall). The margins of the shell are denticulate. The hinge with about 30 anterior and 15 posterior teeth. Length, 35 mm.; height, 22.5 mm.; diameter, 16 mm.

### ***Nucula panamina* Dall.**

*Nucula panamina* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 368, pl. 6, fig. 11. U. S. S. Albatross, station 3360, "Gulf of Panama, in 1672 fathoms, sand, bottom temperature 42°F."

*Type Locality*: Gulf of Panama, in 1,672 fathoms, sand. Type No. 122,894 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell large, thick, solid, rather donaciform with dark polished olivaceous periostracum; interior more or less radially striate, but valve margins smooth and entire; hinge with 20 anterior and 10 posterior teeth. Length 22 mm.; height, 16 mm.; diameter, 9 mm.

### ***Nucula paytensis* A. Adams.**

*Nucula paytensis* A. Adams, *Proc. Zool. Soc. London*, 1856, p. 51. "Hab. Payta, Peru. Mus. Cuming." —Sowerby, *Conch. Icon.*, Vol. 18, *Nucula*, October, 1870, sp. 23, pl. 3, fig. 23. "Hab. Payti, Peru." —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 250. Paita, Peru.

[*Nucula crenulata*] var.? *N. paytensis* A. Adams, Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 154, pl. 230 (*Nuculidae*, pl. 5), figs. 160 and 161. [No locality cited].

*Type Locality*: Paita, Peru.

*Range*: Known only from the type locality.

A very oblique, ovate, gibbose species, concentrically grooved and decussately striated (A. Adams).

### ***Nucula pigafettæ* Dall.**

*Nucula pigafettæ* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 369. U. S. S. Albatross, station 2780, "Magellan Straits, in 369 fathoms, mud, bottom temperature 47°F."

*Type Locality*: Magellan Straits, in 369 fathoms, mud. Type No. 96,243 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell small, inequilateral, with blackish-brown or dark olivaceous periostracum; irregularly concentrically striated and sometimes very minutely radiately striated but not visibly reticulate; hinge with 15-17 anterior and 7 posterior teeth; margins of valves entire. Length, 15 mm.; height, 10.5 mm.; maximum diameter, 7.5 mm.

### *Nucula pisum* Sowerby.

*Nucula pisum* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 198. "Hab. ad Valparaiso." "Dredged in coarse sand and gravel, at various depths from seven to forty fathoms." —Sowerby, *Conch. Illustr., Nuculae*, 1833, p. 6, pl. 16, fig. 23. Valparaiso. —Hanley, *Cat. Rec. Biv. Shells*, p. 172, 1843, p. 376, 1856?, *Suppl.* 20, fig. 12, 1856. Valparaiso. —Hupé, *Hist. de Chile, Zool.*, Vol. 8, 1854, p. 304. Valparaiso, etc. —Hanley, *Thes. Conch.*, Vol. 3, *Nuculidae*, 1860, p. 153, pl. 229 (*Nuculidae*, pl. 4), fig. 133. Valparaiso, Chile. —Philippi, *Los Fos. Terc. i. Cuart. Chile*, 1887, p. 190, pl. 41, fig. 25. Recent on coast of Chile, also "fósil en la hacienda de La Cueva." —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 250. Valparaiso to San Blas, Chile.

*Type Locality*: Valparaiso, Chile, in 7 to 40 fathoms, sand and gravel.

*Range*: Valparaiso to San Blas, Chile.

Reference to the illustration of *Nucula pisum* given in Reeve's<sup>39</sup> *Conchologia Iconica* has been omitted by us from the synonymy of this species because von Ihering<sup>40</sup>, stated that the illustration is definitely that of *N. semiornata* d'Orbigny, an Atlantic species.

### *Nucula savatieri* Mabile & Rochebrune.

*Nucula savatieri* Mabile & Rochebrune, *Miss. Sci. Cap Horn*, Vol. 6, *Zool.*, pt. 2, 1889, p. H 112, pl. 8, figs. 2a, 2b, 2c. "Hab. —Canal du Beagle. Baie Orange." —Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 367, pl. 18, fig. 11. Gulf of Panama, in 322 fathoms; 24 miles off Aguja Point, Peru, in 1036 fathoms; on the west coast of Patagonia in 122 fathoms; Straits of Magellan, in 77 fathoms.

*Type Locality*: Beagle Canal and Orange Bay, Chile.

*Range*: Straits of Magellan, Patagonia, to the Gulf of Panama.

Shell compressed-ovate, very inequilateral, pale olive periostracum; valves with smooth entire margins; hinge with 24 anterior and 10 posterior teeth. Length, 14-21 mm.; height, 10-15 mm.; diameter, 5-8 mm.

### *Nucula taeniolata* Dall.

*Nucula taeniolata* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 368, pl. 7, figs. 3 and 5. U. S. S. *Albatross*, station 3417, "off Acapulco, Mexico, in 493 fathoms, mud, bottom temperature 40.6° F." —Heath, *Mem. Mus. Roy. d'Hist. Nat. Belg.*, Ser. 2, Fasc. 10, 1937, pp. 4, 6, 17, pl. 3, fig. 24 (Anatomy). Acapulco, Mexico, in 493 fathoms.

*Type Locality*: Off Acapulco, Mexico, in 493 fathoms, mud. Type No. 122,897 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell elongate, almost rostrate, thin, polished, and with dark olive-colored periostracum, more or less minutely irregularly wrinkled with a few very faint almost microscopic irregularly distributed radial striae; margins of valves simple, smooth; hinge with 10 anterior and 6 posterior teeth. Length 17 mm.; height, 11 mm.; diameter, 6.5 mm.

<sup>39</sup> *Nucula pisum* Sowerby, Sowerby, *Conch. Icon.*, Vol. 18, *Nucula*, October, 1870, sp. 24, pl. 4, fig. 24.

<sup>40</sup> von Ihering, H., *An. Mus. Nac. Buenos Aires*, Ser. 3, Vol. 7, 1907, p. 227.

**Nucula tanneri** Dall.

*Nucula tanneri* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 367. "Straits of Magellan at station 2780, in 369 fathoms, mud, bottom temperature 47°F." Also on the west coast of Patagonia, in 61 to 348 fathoms, mud, temperature 48° to 54°.

*Type Locality*: Straits of Magellan, in 369 fathoms, mud. Type No. 96,243 U. S. Nat. Mus.

*Range*: Straits of Magellan and west coast of Patagonia.

Shell oval, inequilateral, brownish periostracum with concentric zones of darker and lighter shade; sculpture of faint concentric ripples; margins smooth; hinge with 14-17 anterior and 7-9 posterior teeth. Length, 22.5 mm.; height, 16.5 mm.; diameter, 10.0 mm.

Genus **Acila** H. & A. Adams.

*Acila* H. & A. Adams, *Gen. Rec. Moll.*, Vol. 2, January, 1858, p. 545. ——— Stoliczka, *Mem. Geol. Surv. India, Palaeont. Indica*, *Cret. Fauna South India*, Vol. 3, 1871, p. 325. "*N. divaricata*, Hinds, is the type." ——— Schenck, *Geol. Soc. America, Spec. Publ. No. 4*, 1936. See especially pp. 7-44.

*Type* (designated by Stoliczka): *Nucula divaricata* Hinds. [*Proc. Zool. Soc. London*, 1843, p. 97. China Sea; from eighty-four fathoms. ——— Hinds, *Zool. Voy. Sulphur*, *Moll. pt. 3*, 1844 [January, 1845 on cover of pt. 3], p. 62, pl. 18, fig. 4. "Inhab. China Sea. From eighty-four fathoms." ——— Sowerby, *Conch. Icon.*, Vol. 18, *Nucula*, October, 1870, sp. 29, pl. 4, fig. 29. "*Hab. Chinese Seas.*" ——— Schenck, *Geol. Soc. America, Spec. Publ. No. 4*, 1936, p. 90, pl. 15, figs. 1-10; text fig. 8 (1, 2). Earlier records cited].

The species of the genus *Acila* are characterized by the presence of divaricate sculpture on the shell.

A recent monograph by Schenck<sup>41</sup> of the members of this group should be consulted for information regarding the species of *Acila*. The genus is known from Cretaceous to Recent.

Subgenus **Truncacila** Schenck in Grant & Gale.

*Truncacila* Schenck in Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, November 3, 1931, p. 115. Type: *Nucula castrensis* Hinds. ——— Schenck, *Geol. Soc. Amer.*, *Special Publ. No. 4*, July 18, 1936, p. 23. Type: *Nucula castrensis* Hinds.

*Type* (by original designation): *Nucula castrensis* Hinds.

Shell without the shallow sinus characteristic of the typical section of *Acila*, the posterior end being truncated, as a rule, nearly at right angles (Grant & Gale).

**Acila (Truncacila) castrensis** Hinds.

*Nucula castrensis* Hinds, *Proc. Zool. Soc. London*, 1843, p. 98. "*Hab.* Sitka, Northwest America. A single specimen was dredged in the harbour, from seven fathoms, sand." ——— Hinds, *Zool. Voy. Sulphur*, *Moll.*, Pt. 3, 1844 [Jan. 1845 on cover of Pt. 3], p. 63, pl. 18, fig. 5. "Inhab. Sitka, North-west America. A single specimen was dredged in the harbour, from seven fathoms, sand." ——— Sowerby, *Conch. Icon.*, Vol. 18, *Nucula*, October, 1870, sp. 32, pl. 4, fig. 32. "*Hab.* North-West America."

*Nucula lyalli* Baird, *Proc. Zool. Soc. London*, 1863, p. 71. "*Hab.* Esquimalt Harbour, Vancouver Island; dredged by Dr. Lyall . . . . . in 8 to 10 fathoms."

*Acila castrensis* Hinds, Ashley, *Proc. Calif. Acad. Sci.*, Ser. 2, Vol. 5, 1895, pp. 327, 344. Purisima and Tunitas Creek, San Mateo County, California, Pliocene.

<sup>41</sup> Schenck, H. G. *Nuculid Bivalves of the genus Acila*. *Geol. Soc. America, Special Publ. No. 4*, July, 1936, 149 pp., 18 pls.

Also Miocene to Recent. ———Frizzell, *Nautilus*, Vol. 44, no. 2, 1930, pp. 50-53. Friday Harbor, Puget Sound, Washington, Recent. ———Haas, Dr. H. G. Bronns Klassen u. Ordnung des Tierreichs, Moll., Bivalvia, Bd. 3, Lief. 4, 1933, pp. 529-531, fig. 258.

*Nucula (Acila) castrensis* Hinds, I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, no. 1, 1924, p. 14, pl. 5, fig. 11; pl. 37, figs. 1, 2. Bering Sea to San Diego, California, also Miocene, Pliocene and Pleistocene. ———Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 116, pl. 1, figs. 6a, 6b. Earlier records cited. Miocene to Recent.

*Acila (Truncacila) castrensis* Hinds, Schenck, *Geol. Soc. America, Special Publ.* No. 4, 1936, p. 96, pl. 10, figs. 1-15; pl. 14, figs. 2, 3; text figure 7 (2-5). Pliocene to Recent. Earlier records cited with discussion of the species.

*Type Locality:* Sitka, Alaska, dredged in harbor in 7 fathoms.

*Range:* Sitka, Alaska, to Cedros Island, Lower California, 40 to 262 fathoms.

*Collecting Station:* Mexico: East of Cedros Island (126-D-10). 60 fathoms, crushed shell and eel grass bottom.

A single valve of *Acila castrensis* was dredged about 1¼ miles east of Cedros Island. This is a southern extension in the range of the species. Heath<sup>42</sup> has recently discussed the soft parts of *A. castrensis* and Schenck has discussed the species in detail in his work on *Acila*.

#### Family Nuculanidae.

The shells of the Nuculanidae are somewhat similar to those of the Nuculidae but the posterior end is elongate and rostrate; the ends of the shell are sometimes partly gaping; a ligament is present, often behind the beaks; the interior of the shell is porcellanous or sub-nacreous; the pallial line is sinuate due to the presence of siphons.

Most of the species of the Nuculanidae dwell in muddy portions of the bottom of the sea.

No representatives of *Yoldia*, *Cyrilla*, *Malletia* or of *Tindaria* are present in the collections made by Crocker and Beebe from west American waters. This may be explained in part by the fact that most of the species of such genera as *Yoldia* and *Tindaria* in the region covered by these expeditions occur at depths considerably greater than those from which most of the collections were secured.

#### KEY TO THE GENERA OF NUCULANIDAE.

- A. No lateral teeth on hinge line
  - a. Ligament internal ..... *Nuculana*
  - aa. Ligament external
    - b. Shell pointed posteriorly
      - c. Shell veneriform, thickened..... *Tindaria*
      - cc. Shell elongate
        - d. Shell lanceolate, length more than double width..... *Adrana*
        - dd. Shell broader, length about one third greater than width ..... *Yoldia*
    - bb. Shell rounded posteriorly..... *Malletia*
- B. A well developed lateral tooth in right valve with corresponding depression in left; shell very small..... *Cyrilla*

<sup>42</sup> Heath, H. *Mem. Mus. Roy. d'Hist. Nat. Belg.*, Ser. 2, Fasc. 10, 1937, pp. 4, 9, etc. pl. 4, figs 30, 36; pl. 6, fig. 50; pl. 9, figs. 76, 77. See also Hilton, W. A., *Jour. Entomol. & Zool.*, Vol. 11, no. 4, 1919, p. 77, figs. 1-7. Monterey Bay, California, in 60-80 fathoms, and south of Alaskan Peninsula, in 483 fathoms.

Genus *Nuculana* Link.

*Nuculana* Link, Beschreib. Nat.-Samml. Univ. Rostock, Abt. 3, May 17, 1807, p. 155. Sole species: "*N. rostrata*" [Chemnitz]. —Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 118. Type: *Arca rostrata* Chemnitz.

*Leda* Schumacher, *Essai Nouv. Syst. Test.*, 1817, pp. 55, 172, 173. Type: *Arca rostrata* Chemnitz. Illustrated by Schumacher on pl. 19, fig. 4.

Type (by monotypy): *Arca rostrata* Chemnitz. [Neues Syst. Conchyl.-Cab., Bd. 7, 1784, p. 206, pl. 55, figs. 550, 551. Recent, northern coasts of Europe. —Montagu, *Suppl. Test. Brit.*, 1808, p. 55, pl. 27, fig. 7. Norwegian and Baltic Seas, also Scotland].

The genus *Nuculana* and closely related forms originated in the Paleozoic. *Praeleda* Pfab<sup>43</sup> has been described from the Silurian of Bohemia and has been recorded from the Ordovician of Belgium. The genus *Nuculana* is widely distributed but the majority of the species occur on muddy bottoms in cold water. Verrill & Bush<sup>44</sup> published a revision of the genera of the Nuculanidae of the Atlantic coast of the United States. Stewart<sup>45</sup> has discussed some of the superspecific groups in the Nuculanidae as has Iredale<sup>46</sup> and Prashad<sup>47</sup>.

KEY TO THE SPECIES OF *Nuculana*.

- A. Umbos distinctly anterior
- a. Surface smooth or with very feeble sculpture
- b. Hinge with 15 anterior and 22 posterior teeth..... *loshka*
- bb. Hinge with 15 anterior and 38 posterior teeth..... *peruviana*
- aa. Surface with distinct concentric sculpture
- c. Umbos at about the anterior fourth
- d. Posterior dorsal margin nearly straight..... *hamata*
- dd. Posterior dorsal margin strongly concave..... *cordyla*
- cc. Umbos at about the anterior third
- e. Anterior end with a distinct radiating ray or shallow groove
- f. Size small, length about 6 mm..... *acuta*
- ff. Size large, length about 20 mm. or more
- g. Concentric sculpture fine, weak..... *marella*
- gg. Concentric sculpture strong, distant ribs..... *costellata*
- ee. Anterior end without a radiating ray or groove or if present, very weak

<sup>43</sup> Praeleda Pfab, *Palaeontogr.*, Bd. 80, Abt. A, Lief. 4-6, April, 1934, p. 231. "Typus des genus: *P. compar* (Barr.)."

<sup>44</sup> Verrill, A. E., & Bush, H. J. Revision of the genera of Ledidae and Nuculidae of the Atlantic Coast of the United States. *Amer. Jour. Sci.*, Ser. 4, Vol. 3, 1897, pp. 51-63, 22 figs. in text. — *Proc. U. S. Nat. Mus.*, Vol. 20, 1898, pp. 775-901.

Yonge (*Phil. Trans. Roy. Soc. London*, Ser. B, Biol. Sci., No. 566, Vol. 230, August 9, 1939, pp. 79-147, 1 pl., 39 figs. in text) has discussed the anatomy of the protobranchiate mollusks.

<sup>45</sup> Stewart, R. B., *Acad. Nat. Sci. Philadelphia, Spec. Publ. No. 3*, 1930, pp. 48-64.

<sup>46</sup> Iredale, T., *Rec. Austral. Mus.*, Vol. 17, no. 4, 1929, pp. 158-159. — *Brit. Mus. (Nat. Hist.) Great Barrier Reef Exped. 1928-29. Sci. Repts. Vol. 5, no. 6, Moll. Pt. 1*, 1939, pp. 238-241. In this paper three new genera of Nuculanidae are proposed. *Eptoleda*, "Type: *Leda darwini* Smith"; *Zygonoleda*, "Type: *Z. corbuloides minutalis* subsp. nov."; *Tepidoleda*, "Type: *T. lata orion* subsp. nov."

Powell (*Proc. Malacol. Soc. London*, Vol. 21, pt. 4, March, 1935, pp. 252-255, pl. 27), has described some Recent and Tertiary Nuculanidae from New Zealand.

<sup>47</sup> Prashad, B., *Siboga Exped.*, Vol. 53c, Lamell., 1932, pp. 18-19.

- h. Anterior end without radiating ray or groove
  - i. Without deeply impressed lines near base. *calcar*
  - ii. With 6 to 8 impressed lines near base, not coincident with lines of growth.....*calcarella*
- hh. Anterior end with a very weak radiating ray or groove .....*cuneata*
- B. Umbos central or subcentral
  - a. Sculpture faint or obsolete over most of the shell
    - b. Striae obsolete on central portion of shell; no radials
      - c. Size large, conspicuous oblique striae posteriorly, length about 35 mm..... *polita*
      - cc. Size smaller, no oblique posterior striae, length about 15 mm. ....*pontonia*
    - bb. Striae present on basal margin, radially rippled..... *acrita*
  - aa. Sculpture strong, continuous, concentric
    - d. Posterior dorsal area defined by two ridges or angles
      - e. Anterior end with a radial ray or groove
        - f. Concentric ridges evenly spaced
          - g. Radiating lyrae well developed
            - h. Radiating lyrae over entire shell.... *hindsii*
            - hh. Radiating lyrae confined to posterior end....  
*crispa*
          - gg. Radiating lyrae, if present, very fine, confined to the umbonal region
            - i. Anterior groove shallow, barely discernible..  
*eburnea*
            - ii. Anterior groove very conspicuous.....*ornata*
        - ff. Concentric ridges not evenly spaced
          - j. Ridges widely spaced toward umbos, close toward margin ..... *impar*
          - jj. Ridges irregularly spaced.....*elenensis*
    - ee. Anterior end without a radial ray or groove
      - k. Posterior end obtuse (60°), shell thin, fragile... *agapea*
      - kk. Posterior end acute, shell solid.....*bicostata*
  - dd. Posterior dorsal area with not more than one ridge or angle
    - l. size small, length less than 25 mm.
      - m. Dorsal area defined by one ridge, posterior end attenuated.
        - n. Concentric sculpture extending at least to posterior dorsal ridge
          - o. Size about 15 to 20 mm.
            - p. Anterior hinge teeth 26, posterior 20 ...  
*callimene*
            - pp. Anterior hinge teeth 12, posterior 12 ...  
*taphria*
          - oo. Size smaller, length 10 mm. or less
            - q. Length about 10 mm.....*excavata*
            - qq. Length about 5 mm.....*oxia*
      - nn. Shell smooth, at least in front of posterior dorsal ridge .....*laeviradius*

KEY TO THE SPECIES OF *Nuculana* (continued):

- mm. Posterior dorsal area without ridge or angle, both ends rounded
- r. Anterior end without a radiating ray or groove
- s. Posterior end attenuated but not acute ..... *rhytida*
- ss. Both ends evenly rounded ..... *lobula*
- rr. Anterior end with a radiating ray or groove ..... *lucasana*
- ll. Size large, shell heavy, length over 30 mm. .... *gibbosa*

Subgenus **Saccella** Woodring.

*Ledina* Sacco, Moll. Terr. Terz. Piemonte e Liguria, Pt. 26, December, 1898, p. 53. "(tipo *L. fragilis* (Chemnitz).)"

Not *Ledina* Dall, *Trans. Wagner Free Inst. Science*, Vol. 3, pt. 4, April, 1898, p. 580. Type: *Leda eborea* Conrad, 1860 (not *L. eborea* Conrad, 1846) = *L. smirna* Dall, Eocene of Gulf States of United States.

*Saccella* Woodring, *Carnegie Inst. Washington, Publ. No. 366*, May 20, 1925, p. 15. Type: *Arca fragilis* Chemnitz (= *Leda commutata* Philippi). New name for *Ledina* Sacco not *Ledina* Dall.

Type (by original designation): *Arca fragilis* Chemnitz. [Neues Syst. Conchyl.-Cab., Bd. 7, 1784, p. 199, pl. 55, fig. 546. "Mittelländischen Meeres." —Bucquoy, Dautzenberg & Dollfus, Moll. Mar. Roussillon, Vol. 2, Fasc. 5 (Pelecypoda, Fasc. 18), 1891, p. 215, pl. 37, figs. 26, 27, 28, 29, 30, 31. Mediterranean, and Atlantic Ocean. (= *Leda commutata* Philippi). Miocene to Recent in the Mediterranean region.]

*Saccella* resembles *Lembulus*<sup>48</sup> but the former has concentric instead of diagonal sculpture and has a narrower and shallower posterior groove. *Saccella* occurs Recent and fossil in Europe, eastern and western North and Central America and elsewhere. It has been recorded fossil in the Eocene of California<sup>49</sup> and Tertiary of New Zealand<sup>50</sup>.

***Nuculana (Saccella) acuta* Conrad.**

Plate I, Figure 11.

*Nucula acuta* Conrad, Amer. Mar. Conch., 1832, p. 32, pl. 6, fig. 3. North Carolina; Recent.

*Leda acuta* Conrad, Verrill, *Trans. Connecticut Acad. Arts and Sci.*, Vol. 6, 1884, p. 259, pl. 30, fig. 15. New England Coast. —Dall, *Bull. Mus. Comp. Zool.*, Vol. 12, no. 5, 1886, p. 251, pl. 7, figs. 3a, 3b, 8 [Not all the synonymy]. New England; Florida; Jamaica. —Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, pt. 4, 1898, p. 592. Oligocene to Recent on Atlantic Coast. Also Recent on Pacific Coast of California. —Dall & Simpson, *Bull. U. S. Fish Comm.*, Vol. 20, pt. 1, for 1900 (issued separately November 29, 1901), p. 458. Mayaguez Harbor, Porto Rico. —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 250. California, the Gulf of Panama, and south to Valparaiso, Chile. Also Atlantic. —Gardner, *U. S. Geol. Surv., Prof. Paper 142-A*, 1926, p. 12, pl. 2, figs. 13-16. Eastern North America; Miocene to Recent.

<sup>48</sup> *Lembulus* Risso, Hist. Nat. l'Europ. Merid., Vol. 4, 1826, p. 319. Type (designated by Gray, 1847): *Lembulus rossianus* Risso (= *Arca pella* Linnaeus). Recent, Mediterranean Sea. Illustrated by Risso, 1826, pl. 11, fig. 163, and by Bucquoy, Dautzenberg & Dollfus, Moll. Mar. Roussillon, Vol. 2, Fasc. 5 (Pelecypoda, Fasc. 18), 1891, p. 218, pl. 37, figs. 32, 33, 34, 35. Mediterranean; Adriatic; Atlantic Ocean.

<sup>49</sup> Vokes, H. E., *Ann. New York Acad. Sci.*, Vol. 38, 1939, pp. 41-43.

<sup>50</sup> See *Nuculana (Saccella) duplicarina* Laws, *Trans. and Proc. Roy. Soc. New Zealand*, Vol. 68, pt. 4, March, 1939, p. 468, pl. 62, fig. 2. Pakaurangi Point, Kaipara Harbor, New Zealand, Tertiary. —See also, Marwick, *Geol. Surv. New Zealand, Palaeo. Bull. No. 13*, 1931, pp. 50, 51.



*Nuculana acuta* Conrad, M. Smith, East Coast Mar. Shells (Edwards Bros., Ann Arbor, Michigan), 1937, p. 26, pl. 2, fig. 2. Off Martha's Vineyard to the West Indies.

*Type Locality*: North Carolina.

*Range*: Off Martha's Vineyard, Massachusetts, to the West Indies.

*Nuculana acuta* has been recorded from various localities on the west coast ranging from Alaska to Chile. Dall in 1909 cited the range as from California south to Chile. In a later work<sup>51</sup> he cited it as occurring from Nazan Bay, Atka Island, Aleutian Islands, Alaska, to the Gulf of California. The species is well known on the Atlantic coast from Massachusetts to the West Indies, but its occurrence in Western America can be considered very doubtful until definitely proved.

### ***Nuculana (Saccella) callimene* Dall.**

Plate I, Figure 13.

*Leda (Jupiteria) callimene* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 372, pl. 17, figs. 3 and 4. "U. S. S. 'Albatross,' Station 3396, Gulf of Panama, 259 fathoms, mud, bottom temperature 47.4° F." Also at Tomé, Chile, in 14 fathoms.

*Leda callimene* Dall, Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 250. Gulf of Panama to Tomé, Chile. —Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 37. Panama.

*Type Locality*: Gulf of Panama, in 259 fathoms, mud. The type is No. 122,910 U. S. Nat. Mus.

*Range*: Gulf of Nicoya to Tomé, Chile.

*Collecting Station*: Costa Rica: 3 miles south of Blanco Island, Gulf of Nicoya. 100 fathoms.

A single specimen of *Nuculana callimene* was dredged in the Gulf of Nicoya. Compared to *N. taphria* Dall it is more elongate, less inflated, and the exterior surface is less polished.

Specimens somewhat similar to *Nuculana callimene* have been recorded by E. K. Jordan<sup>52</sup> from the Pleistocene of Magdalena Bay, Lower California.

### ***Nuculana (Saccella) elenensis* Sowerby.**

Plate I, Figures 12, 14, 15, 16, 17, 18, 19, 22.

*Nucula elenensis* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 198. "*Hab.* ad Sanctam Elenam." "Dredged in sandy mud at a depth of six fathoms." Recent. —Sowerby, *Conch. Illustr.*, *Nuculae*, 1833, p. 4, pl. 15, fig. 14. "St. Elena, Mr. Cuming." —Müller, *Synop. Test. Viv.*, 1836, p. 191. Type locality cited. —Reeve, *Conch. Syst.*, Vol. 1, 1841, p. 111, pl. 85, fig. 14. —Hanley, *Cat. Rec. Bivalve Shells*, 1843, p. 169, Suppl. pl. 19, fig. 56, 1846. "W. Colombia." —C. B. Adams, *Ann. Lyceum Nat. Hist. New York*, Vol. 5, 1852, p. 478. Panama. Also earlier records cited.

*Leda ?elenensis* Sowerby, Carpenter, *Cat. Mazatlan Shells*; February, 1856, p. 145. Mazatlan, Mexico. Also earlier records cited.

*Leda elenensis* Sowerby, d'Orbigny, *Voy. Amér. Mérid.*, Vol. 5, 1846, p. 545. Santa Elena, Ecuador. —Hanley, *Thes. Conch.*, Vol. 3, 1860, *Leda*, p. 121, pl. 228, [*Nuculidae*, pl. 3], figs. 70, 71, 72. Panama. —Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, September, 1871, sp. 32, pl. 6, figs. 32a, 32b. "*Hab.* St. Elena.

<sup>51</sup> Dall, W. H., *U. S. Nat. Mus., Bull.* 112, 1921, p. 10.

<sup>52</sup> *Leda* sp. aff. *callimene* Dall (young), E. K. Jordan, *Bull. South. Calif. Acad. Sci.*, Vol. 23, pt. 5, September-October (issued October 25), 1924, p. 148. Quaternary at Magdalena Bay, Lower California. —E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1, no. 4, 1936, p. 112. Previous record cited.

Panama." —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 251. Santa Elena, Ecuador. —Olsson, *Nautilus*, Vol. 37, no. 4, 1924, p. 126. Salinas, Ecuador.

*Leda elenensis* Sowerby var. *gibbosa* Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 121.

*Leda elenensis* Sowerby var. *media* Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 121.

*Leda elenensis* Sowerby var.? *pyriformis* Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 121.

*Leda (Jupiteria) elenensis* Sowerby, Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, p. 374, October, 1908. In 52 fathoms in Panama Bay.

*Leda (Saccella) acapulcensis* Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, May 21, 1932, p. 107, pl. 17, figs. 1 and 2. "Mexico: Acapulco, 20 fathoms."

*Nuculana acapulcensis* Pilsbry & Lowe, Strong, Hanna & Hertlein, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 21, no. 10, December 21, 1933, p. 118. Acapulco, Mexico.

*Nuculana elenensis* Sowerby, Hertlein, *Bull. South. Calif. Acad. Sci.*, Vol. 33, pt. 2, May-August (issued August 31), 1934, p. 65. San Ignacio Lagoon, Lower California; Pleistocene. —E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1, no. 4, 1936, pp. 112, 118. Magdalena Bay, Lower California; Pleistocene. Recent, Panama and Santa Elena, Ecuador.

*Nuculana elenense* Sowerby, Strong & Hertlein, *Allan Hancock Pacific Exped. (Univ. South. Calif.)*, Vol. 2, no. 12, 1939, p. 183. Bahia Honda, Veragua, Panama; off Taboga Island, Panama.

*Type Locality*: Santa Elena, Ecuador, in 6 fathoms, sandy mud.

*Range*: Santa Inez Bay, Lower California, to Salinas, Ecuador.

*Collecting Stations*: Mexico: Arena Bank, Gulf of California (136-D-13,-18). 40-45 fathoms, mud and *Arca* conglomerate bottom; Santa Inez Bay, Gulf of California (144-D-2). 2½ fathoms, sand, weed and rock bottom; also (145-D-1,-3, and shore). 4-13 fathoms, sand bottom; Tenacatita Bay (183-D-3). 40 fathoms, sandy mud bottom; Manzanillo (184-D-2). 30 fathoms, gravelly sand bottom; Acapulco (189-D-3). 13 fathoms, mud bottom; 4 miles south-southwest of Maldonado Point (192-D-3). 38 fathoms, mud bottom; Port Guatulco (195-D-19). 17 fathoms, gray mud and crushed shell bottom; Tangola-Tangola Bay (196-D-17). 23 fathoms, mud bottom; Costa Rica: Port Parker (203-D-1,-3). 12-15 fathoms, shelly mud bottom.

*Nuculana elenensis* Sowerby is a very variable species and as pointed out by Jordan neither the form nor sculpture is constant in a series. Sowerby gave the varietal names, *gibbosa*, *media* and *pyriformis*, to forms of this species. With a very large series of shells from many localities we can find no constant distinguishing feature for separation of Pilsbry & Lowe's species *acapulcensis*. They compared it with *Leda agapea* Dall which we have not seen. The specimens here referred to *elenensis* have a strong groove on the anterior end. This is not shown on the figures of *acapulcensis* Pilsbry & Lowe. We have studied a series of several hundred specimens from Sta. 203-D-3. These agree well with Hanley's figure 71 (*Thes. Conch.*, Vol. 3, pl. 228, *Nuculidae*, pl. 3). Almost none of our specimens show the nearly smooth area near the ventral margin as shown by Pilsbry & Lowe on their pl. 17, fig. 1. One specimen in the collection shows a tendency toward this type of sculpture and in many of the larger specimens there is a definite line beyond which the sculpture is somewhat finer.

*Nuculana bicostata* Sowerby appears to be distinguished by the presence of two pronounced rostral ribs while there is but one rib on the posterior part of *N. elenensis*. *Nuculana acuta* Conrad is more truncate posteriorly and is more compressed than *N. elenensis*. The shorter and more contracted posterior portion of the shell serves to separate *N. elenensis* from young specimens of *N. peruviana* Dall from Peru.

***Nuculana (Saccella) eburnea* Sowerby.**

Plate II, Figures 1, 2, 3.

*Nucula eburnea* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 198. "Hab. ad oras Columbiae Occidentalis." "Found in sandy mud, at a depth of from seven to nine fathoms, in the Bay of Caraccas." —Sowerby, *Conch. Illustr.*, *Nuculae*, 1833, pp. 4, 6, pl. 15, fig. 10. Bay of Caraccas. —Müller, *Synop. Test. Viv.*, 1836, p. 191. Type locality cited. —Reeve, *Conch. Syst.*, Vol. 1, 1841, p. 111, pl. 85, fig. 10. —Catlow, *Conch. Nomencl.*, 1845, p. 53. —Hanley, *Cat. Rec. Bivalve Shells*, p. 169, 1843, 376, ?1856, Suppl. pl. 19, fig. 57, 1846. W. Colombia.

*Leda eburnea* Sowerby, d'Orbigny, *Voy. Amér. Mérid.*, Vol. 5, 1846, p. 546. "M. Cuming l'a découverte dans la baie de Caracas, sur la côte occidentale de la république de l'Equateur." —Carpenter, *Rept. Brit. Assoc. Adv. Sci.* for 1863 (issued 1864), p. 560. Reprint in *Smithson. Misc. Coll.*, No. 252, 1872, p. 46. Panama; Bay of Caraccas. —Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 124, pl. 228 (*Nuculidae*, pl. 3), fig. 90. Panama; Bay of Caraccas. —Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, September, 1871, pl. 5, fig. 29. "Hab. Bay of Panama." —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 250. "Gulf of Panama to the Bay of Caragues, Ecuador." —Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 37. Panama.

*Nucula lyrata* Hinds, *Proc. Zool. Soc. London*, 1843, p. 100. "Hab. Panama; from thirty fathoms." —Hinds, *Zool. Voy. Sulphur*, 1844 (January, 1845 on the cover of *Moll.*, Pt. 3), p. 64, pl. 18, fig. 12. Original locality cited.

*Type Locality*: Bay of Caraccas, Ecuador, in 7 to 9 fathoms, sandy mud.

*Range*: Meanguera Island, Gulf of Fonseca, El Salvador, to Bay of Caraccas, Ecuador.

*Collecting Stations*: El Salvador: Meanguera Island, Gulf of Fonseca (199-D-1). 16 fathoms, sandy mud and crushed shell bottom; Nicaragua: Corinto (200-D-19). 12-13 fathoms, mangrove leaves on bottom; Costa Rica: 14 miles southeast of Judas Point (214-D-1 to 4). 42-61 fathoms, mud, shell and rocky bottom.

The shell of *Nuculana eburnea* Sowerby has a smooth or appressed area anterior to the posterior keel somewhat resembling *N. laeviradius* Pilsbry & Lowe. It differs from that species in the great size, more acuminate posterior end and in lacking the elevated ridge on the anterior end which runs from the beaks to the anterior ventral margin on *N. laeviradius*. Specimens of *N. eburnea* in the present collection average about 12.6 mm. in length. *Nuculana lyrata* Hinds, originally described from Panama, was considered to be a synonym of *N. eburnea* by Hanley and Carpenter. From an inspection of the figure given by Hinds it appears likely that *N. lyrata* can be considered synonymous with *N. eburnea*.

***Nuculana (Saccella) gibbosa* Sowerby.**

Plate II, Figures 5, 8.

*Nucula gibbosa* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 198. "Hab. ad littora Peruviae." "Found in soft mud, at a depth of five fathoms, at Tumbez in Peru." "A variety, with a less elevated ridge in the centre of the anterior dorsal margin, and of much smaller size, was found in mud, at twelve fathoms, in the Gulf of Nocoioyo." —Sowerby, *Conch. Illustr.*, *Nuculae*, 1833, p. 4, pl. 15, fig. 9. "Gulf of Nocoioyo. Mr. Cuming." —Deshayes, ed. of Lamarck's *Anim. s. Vert.*, Vol. 6, 1835, p. 508. (as *Nucula gibbosa*. Cuming, but in index it is cited as *Nucula gibbosa*). "Habite les mers du Pérou, près des rivages." —Müller, *Syn. Test. Viv.*, 1836, p. 191. Original locality cited. —Reeve, *Conch. Syst.*, Vol. 1, 1841, p. 111, pl. 85, fig. 9. —Hanley, *Cat. Rec. Bivalve Shells*, p. 169, 1843, p. 376, ?1856, Suppl. pl. 19, fig. 55, 1846. Peru.

*Leda gibbosa* Sowerby, d'Orbigny, Voy. Amér. Mérid., Vol. 5, 1846, p. 545. "Côte de Payta (Pérou)." ————Hanley, Thes. Conch., Vol. 3, *Nuculidae*, 1860, p. 120, pl. 228 (*Nuculidae*, pl. 3), fig. 79. Peru. ————Sowerby, Conch. Icon., Vol. 18, *Laeda*, November, 1871, sp. 51, pl. 8, fig. 51. "Hab. Peru." ————Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 251. Gulf of Panama to Paita, Peru. ————Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 37. Panama. ————Strong, Hanna & Hertlein, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 21, no. 10, 1933, p. 118. Acapulco, Mexico.

*Leda (Jupiteria) gibbosa* Sowerby, Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, 1908, p. 372. Panama Bay in 26 to 47 fathoms, mud.

*Nuculana gibbosa* Tomlin, *Jour. Conch.*, Vol. 18, no. 7, 1928, p. 189. Coiba Island, Panama, in 10 fathoms. Gorgona Island, Colombia, in 20 fathoms.

*Type Locality*: Tumbez, Peru, in 5 fathoms, soft mud.

*Range*: Acapulco, Mexico, to Tumbez, Peru.

*Collecting Stations*: Mexico: Tangola-Tangola Bay (196-D-19). 30 fathoms, mud bottom; Costa Rica: off Ballena Bay, Gulf of Nicoya (213-D-11-17). 35-45 fathoms, mud bottom.

This is a thick, elongate, posteriorly pointed shell with fairly gibbous beaks. It is ornamented by strong concentric somewhat upturned ribs which are separated by smooth bottomed grooves.

### ***Nuculana (Saccella) impar* Pilsbry & Lowe.**

Plate II, Figure 6.

*Leda impar* Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, May 21, 1932, p. 106, pl. 17, figs. 3, 4, 5, 6. "Mexico: Guaymas, 20 fathoms." ————Hertlein, *Bull. South. Calif. Acad. Sci.*, Vol. 33 pt. 2, May-August (issued August 31), 1934, p. 62. Maria Magdalena Island, Tres Marias Islands; Pleistocene. ————Lowe, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, no. 6, 1935, p. 27. Punta Penasco, Sonora, Mexico.

*Type Locality*: Guaymas, Mexico, in 20 fathoms. Type No. 155636 Acad. Nat. Sci. Philadelphia.

*Range*: Punta Penasco, Sonora, Mexico, to Port Parker, Costa Rica.

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (145-D-1,-3). 4-13 fathoms, sand bottom; Costa Rica: Port Parker (203-D-3). 12 fathoms, shelly mud bottom.

The sculpture of this species is characteristic. This consists of concentric ridges, which are fine and close on the beaks, then widely spaced, then again becoming closer and about equal to their intervals from about the middle of the valves to the ventral margin.

### ***Nuculana (Saccella) laeviradius* Pilsbry & Lowe.**

Plate II, Figures 4, 7.

*Leda laeviradius* Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, May 21, 1932, p. 106, pl. 17, fig. 7. "Mexico: Guaymas, 20 fathoms."

*Leda leviradius* Pilsbry & Lowe, Lowe, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, no. 6, 1935, p. 27. Punta Penasco, Sonora, Mexico.

*Type Locality*: Guaymas, Mexico, in 20 fathoms. Type No. 155635 Acad. Nat. Sci. Philadelphia.

*Range*: Punta Penasco, Sonora, Mexico, to Port Parker, Costa Rica.

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (145-D-1,-3). 4-13 fathoms, sand bottom; Costa Rica: Port Parker (203-D-1,-3). 12-15 fathoms, sandy mud, crushed shell and shelly mud bottom.

The presence of a smooth band preceding the posterior ridge and the strong hinge in proportion to the size of the shell are characteristic features of this species. In some specimens a considerable portion of the exterior of the shell is smooth.

### *Nuculana (Saccella) taphria* Dall.

*Nucula caelata* Hinds, *Proc. Zool. Soc. London*, December, 1843, p. 99. "Hab. California, between 38° 18' and 34° 24' north latitude; namely, at Russian Bodegas, San Francisco, and Santa Barbara, in from six to ten fathoms." "Cab. Belcher." —Hinds, *Zool. Voy. Sulphur, Moll.*, pt. 3, 1844 [January, 1845 on cover of pt. 3], p. 64, pl. 18, fig. 13. Original locality cited.

Not *Nucula coelata* Conrad, *Amer. Jour. Sci.*, Vol. 23, no. 2, January, 1833, p. 343. Claiborne, Alabama. London Clay. [Eocene].

*Leda caelata* Hinds, Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 129, pl. 228 (*Nuculidae*, pl. 3), figs. 95, 96. California. —Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, February, 1871, sp. 6, pl. 2, figs. 6a, 6b. "Hab. California."

*Leda taphria* Dall, *Nautilus*, Vol. 10, no. 6, Oct., 1896, p. 70. New name for *Nucula caelata* Hinds, not *Nucula caelata* Conrad, 1833. Claiborne, Eocene. —Dall, *Nat. Hist. Soc. Brit. Columbia, Bull.* No. 2, January, 1897, p. 7 (in text), pl. 2, figs. 6 and 8. Bodega Bay, California to San Diego. —Arnold, *Proc. U. S. Nat. Mus.*, Vol. 32, 1907, p. 544, pl. 48, figs. 5, 5a. Pliocene to Recent in the California Province. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, no. 1, 1924, p. 16, pl. 37, figs. 7, 7a, 8. Bodega Bay, California to Lower California. Also Miocene to Recent in California.

*Nuculana taphria* Dall, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 121, pl. 1, figs. 8 and 9. Earlier records cited. Miocene to Recent. —Hertlein, *Bull. South. Calif. Acad. Sci.*, Vol. 33, pt. 2, May-August (issued August 31), 1934, p. 62. Maria Magdalena Island, Tres Marias Islands; Pleistocene. —E. K. Jordan, *Contrib. Dept. Geol. Stanford Univ.*, Vol. 1, no. 4, 1936, p. 112. Magdalena Bay, Lower California (Dall); Pleistocene. —Willett, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, no. 30, 1937, p. 386. About 2 miles NE. of Playa del Rey, Baldwin Hills, Los Angeles County, California; Upper Pleistocene.

*Type Locality*: Bodega Bay, California, in 6 to 10 fathoms.

*Range*: Bodega Bay, California, to Punta Arena, Lower California.

*Collecting Stations*: Mexico: East of Cedros Island (126-D-12). 45 fathoms, crushed shell and mud bottom; Arena Bank, Gulf of California (136-D-22). 45 fathoms, mud bottom.

The concentric sculpture on this species is uniform and prominent. The beaks are nearly central and the rostrum is rather bluntly pointed.

Heath<sup>53</sup> has studied the soft parts of this species.

### Subgenus *Politoleda* Hertlein & Strong, nov.

*Type*: *Nucula polita* Sowerby.

Shell elongate, posteriorly pointed. Sculpture consists of very fine concentric lines of growth, and on the lower half of the shell fine wavy incised lines which on the whole posterior dorsal part of the shell are nearly parallel to the posterior dorsal margin.

### *Nuculana (Politoleda) polita* Sowerby.

Plate II, Figure 9.

*Nucula polita* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 198. "Hab. ad Panamam." "A single specimen of this very beautiful species was dredged up in sand from a depth of seven fathoms." —Sowerby,

<sup>53</sup> Heath, H., *Mem. Mus. Roy. d'Hist. Nat. Belgique*, Ser. 2, Fasc. 10, 1937, pp. 5, 6, etc., pl. 7, figs. 59, 60.

Conch. Illustr., *Nuculae*, March 8, 1833, p. 4, pl. 15, fig. 11. "Panama. Mr. Cuming."  
 —Deshayes, ed. of Lamarck's Anim. s. Vert., Vol. 6, 1835, p. 507. Panama.  
 —Hanley, Cat. Bivalve Shells, p. 169, 1843, Suppl. pl. 19, fig. 53, 1846.  
 Panama. —Müller, Syn. Test. Viv., 1836, p. 190. "Legit H. Cuming ad Panamam."  
 —Reeve, Conch. Syst., Vol. 1, 1841, p. 111, pl. 85, fig. 11.

*Leda polita* Sowerby, Hanley, Thes. Conch., Vol. 3, *Leda*, 1860, p. 125, pl. 228  
 (*Nuculidae*, pl. 3), fig. 68. Panama. —Sowerby, Conch. Icon., Vol. 18, *Laeda*,  
 September, 1871, sp. 16, pl. 3, fig. 16. "Hab. Panama." —Zetek, *Rev. Nueva*,  
 Nos. 1 & 2, 1918, p. 37. Panama. —Pilsbry & Lowe, *Proc. Acad. Nat. Sci.*  
*Philadelphia*, Vol. 84, p. 141, 1932. On the beach at Old Panama.

*Nuculana polita* Sowerby, Strong & Hertlein, *Allan Hancock Pac. Exped.*  
 (*Univ. South. Calif.*), Vol. 2, no. 12, 1939, p. 183. Beach near Panama Vieja  
 (Old Panama).

*Type Locality*: Panama, in 7 fathoms, sand.

*Range*: Champerico, Guatemala, to Panama.

*Collecting Stations*: Guatemala: 7 miles west of Champerico (197-D-1-2). 14 fathoms, mud bottom; El Salvador: La Libertad (198-D-2). 14 fathoms, mud bottom; Meanguera Island, Gulf of Fonseca (199-D-1). 16 fathoms, sand, mud, and crushed shell bottom; Panama: Gulf of Chiriqui (221-D-1-5). 35-40 fathoms, sandy mud bottom.

The shell of *Nuculana polita* is oblong, anteriorly beaked, ornamented by subdued concentric striae and by oblique striae on the lower part and over the whole posterior portion of the shell. Young specimens 15 mm. in length lack the oblique striae. Specimens reach a length of 45 mm. *Nuculana guppyi* Dall<sup>54</sup> from the Miocene of Trinidad bears some similarity to *N. polita* but has a more attenuated shell and the beaks are more anterior.

### Subgenus *Costelloleda* Hertlein & Strong, nov.

*Type*: *Nucula costellata* Sowerby.

Shell elongate and with strong concentric sculpture. *Costelloleda* is somewhat similar in general appearance to *Poroleda* Iredale<sup>55</sup> and *Thestylela* Iredale.

### *Nuculana (Costelloleda) costellata* Sowerby.

Plate II, Figure 10.

*Nucula costellata* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 198. "Hab. ad Panamam." "Two specimens were taken in sandy mud at a depth of ten fathoms." —Sowerby, Conch. Illustr., *Nuculae*, 1833, p. 4, pl. 15, fig. 8. "Panama." —Müller, Syn. Test. Viv., 1836, p. 191. "Legit H. Cuming ad Panamam." —Reeve, Conch. Syst., Vol. 1, 1841, p. 110, pl. 85, fig. 8. —Hanley, Cat. Rec. Bivalve Shells, p. 169, 1843, p. 376, ?1856, Suppl. pl. 19, fig. 54, 1846. "Panama."

*Leda costellata* Sowerby, Hanley, Thes. Conch., Vol. 3, 1860, p. 111, pl. 228 D-1,-4). 25-29 fathoms, mud, crushed shell and sand bottom; Cape San Lucas, September, 1871, sp. 24, pl. 4, fig. 24. "Hab. Panama." —Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 37. Panama. —Strong, Hanna & Hertlein, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 21, no. 10, 1933, p. 118. Acapulco, Mexico.

*Leda (Leda) costellata* Sowerby, Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, p. 375, 1908. Gulf of California to Panama. Sta. 2823, in 26 fathoms.

<sup>54</sup> See *Leda guppyi* Dall, Maury, *Bull. Amer. Paleol.*, Vol. 10, Bull. No. 42, p. 174 (22), pl. 23 (12), fig. 3, 1925. Manzanilla, Trinidad; Miocene.

<sup>55</sup> *Poroleda* Tate, *Jour. Roy. Soc. New South Wales*, Vol. 27, 1893, p. 186. "Examples: — *Scaphula (?) elongata*, Hutton, *Trans. N. Z. Inst.*, XVII., p. 332, 1885. *Poroleda lanceolata*, Tate." —Cotton & Godfrey, *Moll. South Australia*, Pt. 1. Handbook of Flora and Fauna of South Australia, issued by South Australian Branch Brit. Sci. Guild, Adelaide, 1938, p. 45. Type: *Poroleda lanceolata* Hutton [Tate, 1893, p. 186, pl. 12, fig. 6. Gellibrand River, Australia; Eocene].

*Leda rostellata* Sowerby, Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, 1932, p. 141. Acapulco, Mexico, dredged in 20 fathoms.

*Type Locality*: Panama, in 10 fathoms, sandy mud.

*Range*: Santa Inez Bay, Lower California, to Panama.

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (143-D-1,-4). 25-29 fathoms, mud, crushed shell and sand bottom; Cape San Lucas, Lower California; El Salvador: Meanguera Island, Gulf of Fonseca (199-D-1). 16 fathoms, sand, mud and crushed shell bottom; Costa Rica: 14 miles southeast of Judas Point (214-D-1-4). 42-61 fathoms, mud, shell and rocks on bottom.

Oblong, thin, covered with small concentric acute riblets; anteriorly beaked and acuminated, with two dorsal approximated and crenulated ribs (Hanley).

Several specimens of *Nuculana costellata* were collected, usually only one or two at a locality. Most of these specimens are very large compared to those which have appeared previously in the literature, but they do not differ otherwise.

*Nuculana flexuosa*<sup>56</sup>, described from the lower Miocene of Florida, was compared to *N. costellata* by Heilprin but judging from the figures it does not appear to be very closely related to the west coast species.

***Nuculana (Costelloleda) marella* Hertlein, Hanna & Strong, sp. nov.**

Plate II, Figures 12, 13.

[?] *Leda cestrota* Dall, Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, 1932, p. 141. "Dredged at 20 fathoms, Acapulco."

Not *Leda cestrota* Dall, *Proc. U. S. Nat. Mus.*, Vol. 12, 1889, p. 255, pl. 13, fig. 7. "Hab. Station 2145, near Colon (Aspinwall), in 25 fathoms, mud."

Shell elongate, slender, compressed, thin, narrowly rostrate, white under a thin light brown epidermis; beaks low, at about the anterior third, posterior dorsal margin only moderately concave and the anterior slightly convex; sculptured with numerous, fine, close spaced concentric laminae; lunular depression very narrow, smooth; escutcheon long, narrow, microscopically striated, the valve margins distinctly elevated, bounded on each valve with two rays separated by a shallow depression running from the beaks to the end of the rostrum, on which the concentric laminae are stronger but flattened; anterior end with a broad, shallow depression running from the beaks to the basal margin; interior polished, hinge with 32 small teeth on the anterior side and about 50 on the posterior side of the central pit. The type measures: longitudinal diameter, 32 mm.; vertical diameter, 11.3 mm.; thickness of the two valves, 5.0 mm.

Holotype, a single specimen, is without definite locality although it probably came from the Gulf of California because it was collected during the expedition to the Gulf of California in 1936. About a dozen single valves and one specimen with both valves were collected at Sta. 221-D-1-5. Lat 7° 54' 15" to 7° 52' 30" N., Long. 82° 02' 45" to 82° 01' 00" W., Gulf of Chiriqui, Panama, 35-40 fathoms, sandy mud bottom.

This species bears a slight resemblance to *Nuculana costellata* Sowerby, but is larger, more rostrate and possesses finer concentric sculpture. The new species bears some resemblance to *Nuculana cestrota* Dall, a species described from the Caribbean and reported by Pilsbry & Lowe from Acapulco, Mexico. The shell of *N. marella* has a greater altitude in proportion to the

<sup>56</sup> *Leda flexuosa* Heilprin, *Trans. Wagner Free Inst. Sci.*, Vol. 1, 1887, p. 119, pl. 16, fig. 66. From the "Silex-bearing marl (Miocene) of Ballast Point, Hillsboro Bay," Florida. —Dall, *U. S. Nat. Mus., Bull.* 90, 1915, p. 117, pl. 23, figs. 8 and 10.

length and is therefore not so slender, and the anterior and posterior dorsal slopes are straighter than those of the species described by Dall.

### Subgenus *Thestyleda* Iredale.

*Thestyleda* Iredale, *Rec. Australian Mus.*, Vol. 17, no. 4, September 4, 1929, pp. 158, 187. "Type *Leda ramsayi* E. A. Smith."

*Type* (by original designation): *Leda ramsayi* E. A. Smith. [Sci. Rept. Voy. Challenger, Zool., Vol. 13, 1885, p. 241, pl. 20, figs. 3, 3a. "off Sydney, New South Wales, in 950 fathoms; green mud."]

Shell of medium size, thin, elongate, umbos slightly tumid, acutely rounded anteriorly, rostrate posteriorly; anterior dorsal slope short, posterior dorsal slope more than twice as long, concave in anterior half then almost straight; ventral margin convexly rounded anteriorly then continuing in an almost straight line to the posterior end which is squarely truncated; ornamented by well marked regular concentric rugae which turn upward at almost a right angle upon crossing the lower keel; two radiating ridges form keels along the rostrum; hinge, consisting of anterior and posterior series of chevron shaped teeth; chondrophore large.

The west American species *Nuculana hamata* and *N. cordyla* appear to be referable to the subgenus *Thestyleda*.

### *Nuculana (Thestyleda) hamata* Carpenter.

Plate II, Figure 14.

*Leda hamata* Carpenter, *Rept. Brit. Assoc. Adv. Sci.* for 1863 (issued 1864), pp. 612, 644. "Santa Barbara; Cat. Is., 20-60 fm.; common." Reprint in *Smithson. Misc. Coll.*, No. 252, 1872, pp. 98, 130. —Carpenter, *Proc. Calif. Acad. Sci.*, Vol. 3, February, 1866, p. 210. Coast of California. —Cooper, *Geol. Surv. Calif., Geogr. Catalog. Moll.*, 1867, p. 12. "Santa Barbara 16-28 fms. Catalina I.?" —Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, November, 1871, sp. 56, pl. 9, fig. 56. "*Hab.* Catalina Islands." —Dall, *Proc. U. S. Nat. Mus.*, Vol. 24, 1902, p. 558, pl. 40, fig. 9. Near Catalina Island, California, in about 50 fathoms. —Arnold, *Mem. Calif. Acad. Sci.*, Vol. 3, 1903, p. 97, pl. 17, fig. 4. Pliocene at Deadman Island, San Pedro, California. Pleistocene of San Pedro and San Diego, California. Recent from Santa Barbara to Santa Catalina Island. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, no. 1, 1924, p. 23, pl. 6, fig. 4; pl. 37, fig. 5. "Type locality, Santa Barbara, California. Range: Puget Sound to Panama Bay. In the Pliocene and Pleistocene of California."

*Nuculana hamata* Carpenter, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 125, pl. 1, figs. 14 and 15. Earlier records cited. Pleistocene and Recent.

Not *Zealeda hamata* Marwick, *Proc. Malacol. Soc. London*, Vol. 16, no. 1, April, 1924, p. 25, figs. 1 and 2 (p. 26). "*Locality.* —Awatere Beds (Pliocene), east shore of Lake Grassmere, Marlborough, New Zealand."

*Type Locality*: Santa Barbara, California.

*Range*: Puget Sound to Panama Bay.

*Collecting Station*: Mexico: East of Cedros Island (126-D-12). 45 fathoms, crushed shell and mud bottom.

The shell of *Nuculana hamata* is extended into a long rostrum posteriorly which is squarely truncated at the end. The exterior of the shell is ornamented by strong concentric sculpture. The sculpture of the subspecies *Nuculana hamata limata* Dall<sup>57</sup> is very variable.

<sup>57</sup> *Leda hamata* Carpenter variety *limata* Dall, *Proc. U. S. Nat. Mus.*, Vol. 52, December 27, 1916, p. 397. "off Santa Rosa Island, California, in 50 fathoms." —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 24 (as *Leda hamata limata*). Type locality cited. Range: Santa Barbara to San Diego, California.



*Nuculana (Thestyleda) elaborata* Prashad<sup>58</sup> described from the East Indies, is a similar species.

### ***Nuculana (Thestyleda) cordyla* Dall.**

*Leda (Leda) cordyla* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 375, pl. 6, figs. 6 and 7. U. S. S. *Albatross* Station 3354, "Gulf of Panama, in 322 fathoms, mud, bottom temperature 46°F." Also at Station 2792, off Manta, Ecuador, in 401 fathoms.

*Type Locality*: Gulf of Panama, in 322 fathoms, mud. Type No. 122,915 U. S. Nat. Mus.

*Range*: Gulf of Panama to Manta, Ecuador, in deep water.

Shell, small, rostrate, with 14 anterior and 19 posterior hinge teeth. It is somewhat similar to *N. hamata*.

### Subgenus ***Spinula*** Dall.

*Spinula* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 377. "Type, *Leda calcar* Dall." —Thiele, *Handbuch syst. Weichtierkunde*, Teil 3, 1934, p. 789. *L. (S.) calcar* Dall, cited.

*Type* (by original designation): *Leda calcar* Dall.

Shell rostrate, acute behind, smooth, with a well-developed short amphidetic ligament, an internal resilium supported by triangular chondrophores, a defined lunule and escutcheon; a long, slender, completely united siphon, no papal tentacles; pallial sinus obsolete (Dall).

*Ledaspinna* Marwick<sup>59</sup> from the Tertiary of New Zealand "differs from *Spinula* Dall in being almost equilateral and not drawn out posteriorly."

### ***Nuculana (Spinula) calcar* Dall.**

*Leda (Spinula) calcar* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 378, pl. 10, figs. 1, 10. U. S. S. *Albatross* station 4658, "off the Peruvian coast, in S. Lat. 8° 30', W. Lon. 85° 36', in 2370 fathoms, green mud, bottom temperature 35.3 F."

*Type Locality*: Off the coast of Peru, in Lat. 8° 30' S., Long. 85° 36' W., in 2370 fathoms, green mud. Type No. 110,573 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell compressed and acutely rostrate; posterior dorsal margin nearly straight, posterior end acutely angular, with a wide shallow sulcus below, setting off the rostrum.

### ***Nuculana (Spinula) calcarella* Dall.**

*Leda (Spinula) calcarella* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 378. U. S. S. *Albatross* station 4656, "off the coast of Peru, in S. Lat. 6° 55' and W. Lon. 83° 34', in 2222 fathoms, green mud, bottom temperature 35.2 F."

*Type Locality*: Off the coast of Peru, in Lat. 6° 55' S., Long. 83° 34' W., in 2,222 fathoms, green mud. Type No. 110,575 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell smaller than *Nuculana calcar* and near the base there are six or eight lines not coincident with the lines of growth.

<sup>58</sup> *Nuculana (Thestyleda) elaborata* Prashad, *Siboga Exped., Monogr.* 53c, Lamell., 1932, p. 22, pl. 1, figs. 32, 33, 34. "Holotype and an odd valve brought up in a deep-sea trawl at St. 52 (9° 3'4 S., 119° 56' 7 E., 959 metres)."

<sup>59</sup> Marwick, J., *Geol. Surv. New Zealand, Palaeo. Bull.* No. 13, 1931, p. 53. "Type (original introduction): *Ledaspinna stimulea* n. sp. Oligocene, New Zealand," p. 53, pl. 2, figs. 21, 24. From Loc. 1240 "Thungia mudstone, Island Creek, Tutamoe, S. D." Oligocene.

Subgenus **Jupiteria** Bellardi.

*Jupiteria* Bellardi, Mon. Nuculidi Terr. Terz. Piemonte e Liguria, 1875, p. 20.  
 —Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, pt. 4, April, 1898, p. 579. "Type *L. concava* Bronn." —Sacco, Moll. Terr. Terz. Piemonte e Liguria, Pt. 26, December, 1898, p. 56. "(Tipo *J. concava* (Brn.))." —Woodring, *Carnegie Inst. Washington, Publ.* 366, 1925, p. 18. Type: *Nucula concava* Bronn.

Type (designated by Dall): *Leda concava* Bronn. [= *Nucula concava* Bronn, Ital. Tert. Gebilde, 1831, p. 110. Italy. From "Ta. c." [= "Tabbiano, links zwischen *Cq.* und *Parma*" in the "Jüngerer Grobkalk, blau, thonig, in den Apenninen."]] —Sacco, Moll. Terr. Terz. Piemonte e Liguria, Pt. 26, December, 1898, p. 56, pl. 12, figs. 1, 2, 3. Several localities in the Pliocene of Italy].

Small corbuloid, strongly inflated shells; blunt and barely ridged rostrum; shallow sinus.

A few of the tropical west American species have been placed under *Jupiteria* by Dall but some of those are now believed to be referable to *Saccella*. It is probable however that some of the west American species may be referable to *Jupiteria*.

*Jupiteria* occurs in the Miocene and Pliocene of the Mediterranean region, in the Midway, early Tertiary of southeastern United States, and from Miocene to Recent in the Caribbean region. It has been recorded from the upper Eocene of California<sup>60</sup>. Marwick & Finlay<sup>61</sup> cited *Jupiteria* from the Danian, upper Cretaceous of New Zealand, Marwick<sup>62</sup> cited it from the Medial Tertiary, and Powell<sup>63</sup> described a species which he referred to *Jupiteria*, from the waters of New Zealand.

An Australian species, "*Leda fortis*"<sup>64</sup>, was believed by Hedley to be referable to *Jupiteria* but Iredale considered the species to belong to his genus *Teretileda*.

The subgeneric position of the following species of *Nuculana* is uncertain.

***Nuculana acrita* Dall.**

*Leda (Jupiteria) acrita* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 374. U. S. S. Albatross Station 2799, "Panama Bay, in 29½ fathoms, mud." Also other localities in Panama Bay, in 14-62 fathoms.

Type Locality: Panama Bay, in 29½ fathoms, mud. Type No. 110,690 U. S. Nat. Mus.

Range: Panama Bay.

Shell small, white, subequilateral, inflated and acutely rostrate posteriorly; hinge with about 15 anterior and 13 posterior teeth. Length, 6.2 mm.; height, 3.8 mm.; diameter, 3.0 mm.

***Nuculana agapea* Dall.**

*Leda (Jupiteria) agapea* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 373, pl. 6, figs. 4 and 5. U. S. S. Albatross station 3360, "Gulf of Panama, in 1672 fathoms, sand, bottom temperature 42°F." Also off the coast of Ecuador in 1573 fathoms.

<sup>60</sup>*Jupiteria (Ledina) duttonae* Vokes, *Ann. New York Acad. Sci.*, Vol. 38, January 4, 1939, p. 44, pl. 1, fig. 6. From Loc. 1817 (Univ. Calif.), S. W. ¼ of N. W. ¼ of Sec. 15, T. 18 S., R. 14 E., 100 feet up the fourth small draw from west end of ridge; immediately opposite the place where Urruttia Canyon enters Salt Creek. Domengine formation, Eocene.

<sup>61</sup>Finlay, H. J., and Marwick, J., *Geol. Surv. New Zealand, Palaeo. Bull.* No. 15, 1937, p. 16.

<sup>62</sup>Marwick, J., *Geol. Surv. New Zealand, Palaeo. Bull.* No. 13, 1931, pp. 51-53.

<sup>63</sup>*Nuculana (Jupiteria) manawatawhia* Powell, *Discovery Repts.*, Vol. 15, 1937, p. 164, pl. 45, fig. 9. "Habitat: Off Three Kings Islands" New Zealand.

<sup>64</sup>*Leda fortis* Hedley, *Rec. Australian Mus.*, Vol. 6, no. 5, July 18, 1907, p. 362, pl. 66, figs. 2 and 3. Dredged from 800 fathoms, 35 miles east of Sydney, Australia, in the Tasman Sea.

*Type Locality:* Gulf of Panama, in 1,672 fathoms, sand. Type No. 122,911 U. S. Nat. Mus.

*Range:* Gulf of Panama to coast of Ecuador, in deep water.

This species is most nearly related to *L. pontonia* Dall, but has the beaks more anterior and the sculpture coarser and more deeply incised (Dall).

### ***Nuculana bicostata* Sowerby.**

*Laeda bicostata* Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, November, 1871, sp. 37, pl. 6, fig. 37. "*Hab. Panama.*"

*Type Locality:* Panama.

*Range:* Known only from the type locality.

Shell arched, semi-ovate, compressed, covered with a pale epidermis, sculptured with nearly concentric ridges undulated at the back and beaded on the ribs; anterior side roundly sub-acuminated with ventral margin roundly convex; posterior side rayed with two crenulated arched ribs, dorsal margin depressed, concave, acute at the end; umbos rounded, elevated (Reeve).

The arched form and distinct elevated and curved posterior ribs seem to distinguish this shell from the varieties of *Laeda elenensis*. (Reeve).

### ***Nuculana crispa* Hinds.**

*Nucula crispa* Hinds, *Proc. Zool. Soc. London*, December, 1843, p. 100. "*Hab. Gulf of Nicoya; from thirty-six fathoms.*" ———Hinds, *Zool. Voy. Sulphur, Moll.*, Pt. 3, 1844 [January, 1845 on cover], p. 64, pl. 18, fig. 14. Original locality cited.

*Leda crispa* Hinds, Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 134, pl. 229 (*Nuculidae*, pl. 4), figs. 107, 108. Gulf of Nicoya. ———Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, November, 1871, sp. 55, pl. 9, fig. 55. "*Hab. Gulf of Nicoya.*"

*Type Locality:* Gulf of Nicoya, in 36 fathoms.

*Range:* Known only from the type locality.

The original illustration of this species shows a small rostrate form with strong concentric sculpture. There is a strong ridge on the rostrum and anterior to this is a narrowly elongate triangular depression separating the ridge from the remainder of the shell.

### ***Nuculana cuneata* Sowerby.**

Plate I, Figures 20 and 21.

*Nucula cuneata* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 198. "*Hab. ad Valparaiso.*" "Dredged in coarse sand and gravel, at various depths, from fourteen to forty-five fathoms." ———Sowerby, *Conch. Illustr.*, *Nuculae*, 1833, p. 4, pl. 15, fig. 15. Valparaiso. New Guinea. ———Reeve, *Conch. Syst.*, Vol. 1, 1841, p. 111, pl. 85, fig. 15. ———Philippi, *Reise durch die Wueste Atacama*, 1860, pp. 176-177. Valparaiso; Paposos, Chile.

*Leda cuneata* Sowerby, Hupé, *Hist. de Chile, Zool.*, Vol. 8, 1854, p. 307. "*Habita Valparaiso y otras partes de la República.*" ———Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 128, pl. 228 (*Nuculidae*, pl. 3), figs. 92, 93. ———Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, September, 1871, sp. 35, pl. 6, figs. 35a, 35b. "*Hab. Valparaiso, New Guinea.*"

*Type Locality:* Valparaiso, Chile, in from 14 to 45 fathoms, sand and gravel.

*Range:* Known with certainty only from the type locality.

Shell small, rostrate-ovate, with an ashy or greenish-olive periostracum, without conspicuous indented ray, and with concentric costellated sculpture.

*Nuculana cuneata* has been recorded from New Guinea but that record is believed to have been based on some similar but different species. According to Hanley<sup>65</sup>, "*Leda inornata*" A. Adams<sup>66</sup>, which was described from New Guinea, is identical with *Nuculana cuneata*. Dall (1909), however, considered *N. cuneata* to be identical with *N. acuta*.

### ***Nuculana excavata* Hinds.**

*Nucula excavata* Hinds, *Proc. Zool. Soc. London*, December, 1843, p. 100. "*Hab.* Panama; dredged among mud in thirty fathoms."——Hinds, *Zool. Voy. Sulphur*, Moll. Pt. 3, 1844 [January, 1845 on cover], p. 64, pl. 18, fig. 17. Original locality cited.

*Leda excavata* Hinds, Hanley, *Thes. Conch.*, Vol. 3, *Nuculidae*, 1860, p. 135, pl. 229 (*Nuculidae*, pl. 4), figs. 104, 105. Panama. ——Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, September, 1871, sp. 38, pl. 6, figs. 38a, 38b. "*Hab.* Panama."

*Type Locality*: Panama, in 30 fathoms, mud.

*Range*: Known only from the type locality.

The original illustration of this species shows an ovate-rostrate shell with a rostral ridge, anterior ray, and concentric sculpture.

### ***Nuculana hindsii* Hanley.**

*Leda hindsii* Hanley, *Proc. Zool. Soc. London*, 1860, p. 440. "*Hab.* Nicoyae fretum?" "Mr. Hinds referred this shell to his *Nucula crispa*; it is very distinct, however, from the delineated type."——Hanley, *Thes. Conch.*, Vol. 3, *Nuculidae*, 1860, p. 135, pl. 229 (*Nuculidae*, pl. 4), fig. 102. Gulf of Nicoya? ——Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, November, 1871, sp. 60, pl. 9, fig. 60. "*Hab.* Gulf of Nicoya?"

*Type Locality*: ? Gulf of Nicoya, Costa Rica.

*Range*: Known only from the type locality.

A small, pointed, ovate-oblong shell with a conspicuous anterior indented ray and fold, and with concentric sculpture.

### ***Nuculana lobula* Dall.**

*Leda (Jupiteria) lobula* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 375. U. S. S. *Albatross* station 3422, "in 141 fathoms, mud, off Acapulco, Mexico, bottom temperature 53°.5"

*Type Locality*: Off Acapulco, Mexico, in 141 fathoms, mud.

*Range*: Known only from the type locality.

Shell small, olivaceous, oval with regular rounded concentric threads; hinge with about 13 anterior and 9 posterior teeth.

### ***Nuculana loshka* Dall.**

*Leda (Leda) loshka* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 376, pl. 17, fig. 2. U. S. S. *Albatross* station 3392, "Gulf of Panama, in 1270 fathoms, hard bottom, temperature 36°.4 F."

*Type Locality*: Gulf of Panama, in 1,270 fathoms, hard bottom. Type No. 122,916 U. S. Nat. Mus.

<sup>65</sup> Hanley, S., *Thes. Conch.*, Vol. 3, *Nuculidae*, 1860, explanation to figs. 92 and 93, pl. 228 (*Nuculidae*, pl. 3).

\* <sup>66</sup> *Leda inornata* A. Adams, *Proc. Zool. Soc. London*, June 16, 1856, p. 48. "*Hab.* New Guinea. Mus. Cuming."

*Range:* Known only from the type locality.

Shell thin, very inequilateral and posteriorly produced in a long rostrum; disk smooth but under a lens showing fine concentric and a few irregular faint radial striations.

### ***Nuculana lucasana* Strong & Hertlein.**

*Nuculana lucasana* Strong & Hertlein, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 22, no. 6, December 31, 1937, p. 160, pl. 34, figs. 9, 12, 13. "Lat. 23° 03' to 23° 06' N., Long. 109° 36' to 109° 31' W., dredged about 10 miles due east of San Jose del Cabo, Lower California, Mexico, in 20 to 220 fathoms."

*Type Locality:* East of San Jose del Cabo, Lower California, Mexico, in 20 to 220 fathoms. Type No. 6966 Calif. Acad. Sci. Paleo. Type Coll.

*Range:* Known only from the type locality.

Shell differing from *Nuculana lobula* Dall in the greater diameter in proportion to the height, and in the presence of an anterior radial depression, a feature not mentioned in the original description of Dall's species.

### ***Nuculana ornata* d'Orbigny.**

*Leda ornata* d'Orbigny, *Voy. Amér. Mérid.*, Vol. 5, 1846, p. 546, pl. 82, figs. 4-6. "rencontrée dans du sable de fond, recueilli à Payta (Pérou)." —Hanley, *Thes. Conch.*, Vol. 3, *Nuculidae*, p. 128, pl. 228 (*Nuculidae*, pl. 3), figs. 97, 98. Payta, Peru. —Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, September, 1871, sp. 36, pl. 6, figs. 36a, 36b, "Hab. Payta, Peru." —Wolf, *Geogr. & Geol. Ecuador* (Leipzig), 1892, p. 631. Pliocene of Uimbi, Ecuador. Recent in region about Paita, Peru. —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 251. Paita, Peru.

*Type Locality:* Paita, Peru, sand.

*Range:* Known only from the type locality.

Shell ovate-elongate, rostrate, subventricose, with fine even concentric sculpture and a strong indented anterior ray.

### ***Nuculana oxia* Dall.**

*Leda oxia* Dall, *Proc. U. S. Nat. Mus.*, Vol. 52, December 27, 1916, p. 395. "Station 2901, off Santa Rosa Island, California, in 48 fathoms, muddy bottom." —Dall, *U. S. Nat. Mus.*, *Bull.* 112, 1921, p. 11. Santa Rosa Island, California, to the Gulf of California. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 18. Type locality and range same as cited by Dall. —E. K. Jordan, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 15, no. 7, 1926, p. 244. San Quintin, Lower California; Pleistocene.

*Nuculana oxia* Dall, Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 125. Earlier records cited. —Keen, *Check List West North Amer. Mar. Moll.* (Stanford Univ. Press), 1937, p. 23. Lat. 23°-34°N.

*Type Locality:* Off Santa Rosa Island, California, in 48 fathoms, mud. Type No. 214,448 U. S. Nat. Mus.

*Range:* Santa Rosa Island, California, to the Gulf of California.

Shell minute, very acute posteriorly, beaks subcentral; sculpture of regular equal concentric ridges with subequal interspaces; a depressed ray from beak to base anteriorly; hinge with about eight teeth on either side of the resilifer.

### ***Nuculana peruviana* Dall.**

*Leda (Leda) peruviana* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 377. "dredged in 1036 fathoms, mud, off Aguja Point, Peru, at station 4654."

*Type Locality*: Off Aguja Point, Peru, in 1,036 fathoms, mud.

*Range*: Known only from the type locality.

Shell large, slender, rostrate; surface mostly smooth but with a few coarse irregular wrinkles on basal half of disk anteriorly; hinge with about 15 anterior and 38 posterior teeth.

### ***Nuculana pontonia* Dall.**

*Leda pontonia* Dall, *Proc. U. S. Nat. Mus.*, Vol. 12, 1889, p. 257, pl. 13, figs. 5, 5b. "Stations 2807, and 2808, in 812 and 634 fathoms, mud and sand, near the Galapagos Islands, Pacific Ocean; temperatures 38°.4 and 40°F." —Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 12. Santa Barbara Islands, California, to Peru and the Galapagos Islands, in deep water. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 20, pl. 1, figs. 4 and 5. Locality and range same as cited by Dall. —Heath, *Mem. Mus. Roy. d'Hist. Nat. Belg.*, Ser. 2, Fasc. 10, 1937, pp. 5, 17, 20. Off San Diego, California, in 822 fathoms.

*Leda (Jupiteria) pontonia* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 374. Off Galapagos Islands; Gulf of Panama; off San Diego, California; in 634 to 1672 fathoms.

*Type Locality*: Near the Galapagos Islands, in 634-812 fathoms, mud and sand.

*Range*: Santa Barbara Islands, California, to Peru, and the Galapagos Islands, in deep water.

Shell stout, strong, inflated with recurved pointed, posterior end; concentric sculpture of fine regular threads which become obsolete on the umbos; hinge with 16 anterior and 13 posterior teeth.

### ***Nuculana rhytida* Dall.**

*Leda (Leda) rhytida* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 376. U. S. S. *Albatross* station 3422, "off Acapulco, Mexico, in 141 fathoms, mud, bottom temperature 53°.5 F."

*Type Locality*: Off Acapulco, Mexico, in 141 fathoms, mud. Type No. 122,918 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell small, elongate-ovate, translucent white, with olive-gray periostracum; posteriorly attenuated but not acute; sculpture of concentric riblets which become obsolete on upper posterior portion of shell; hinge with 11 anterior and nine posterior teeth.

### **Genus *Adrana* H. & A. Adams.**

*Adrana* H. & A. Adams, *Gen. Rec. Shells*, Vol. 2, 1858, p. 547. —Stoliczka, *Mem. Geol. Surv. India. Palaeont. Indica. Cret. Fauna South India*, Vol. 3, 1871, p. 320. "Type *Nuc. [Adrana] lanceolata*, Lam."

*Type* (designated by Stoliczka): *Nucula lanceolata* Lamarck. [Anim. s. Vert., Vol. 6, 1819, p. 58. No locality cited. According to d'Orbigny (Voy. Amér. Mérid., Vol. 5, 1846, p. 545), "Le véritable *N. lanceolata* de Lamarck est propre à la Nouvelle-Holland." According to Hanley (Thes. Conch., Vol. 3, 1860, explanation to pl. 227 (*Nuculidae*, pl. 2, fig. 35) it is *Leda taylori* from Guatemala. Chenu (Man. de Conchyl., Vol. 1, 1862, p. 180, fig. 904) gave an illustration of a shell cited as "*A. lanceolata*, Lamarck," but no locality was cited. The figure given by Chenu and the same figure given by Tryon but cited as *Leda (Adrana) sowerbyana* (Struct. and Syst. Conch., Vol. 3, 1884, pp. 249, 443, pl. 126, fig. 32. "Xipixapi") somewhat resembles

that of *Adrana electa* A. Adams (*Proc. Zool. Soc. London*, 1856, p. 48 (as *Leda electa*) "Hab. Santos, Brazil (Capt. Martin). Mus. Cuming." ——— Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 109, pl. 227 (*Nuculidae*, pl. 2), figs. 40, 41 (as *Leda electa*). Santos, Brazil. ——— Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, February, 1871, sp. 2, pl. 1, figs. 2a, 2b. "Hab. Santos, Brazil"), and so also does that of G. B. Sowerby cited as *Nucula lanceolata* Lamarck (*Gen. Shells*, pl. 102, fig. 1, which Hanley referred to *Leda electa*), and that of G. B. Sowerby II cited as *Laeda sowerbyana* (*Conch. Icon.*, Vol. 18, *Laeda*, pl. 1, fig. 1a)].

The shells referred to this genus are very elongate, lanceolate, and often have nearly straight dorsal margins, the beaks scarcely projecting; the sculpture is fine and composed of concentric or somewhat oblique riblets.

Nine species of *Adrana* have been described from tropical west American waters. Three of these, *Adrana elongata* Sowerby, *A. sowerbyana* d'Orbigny and *A. suprema* Pilsbry & Olsson, have large shells with a nearly straight dorsal border. The others are smaller and the dorsal border slopes somewhat in each direction from the beak. No species of *Adrana* has been described from the Tertiary of western North America but several have been recorded from Eocene<sup>67</sup> to Recent in the southeastern part of the United States and from Miocene<sup>68</sup> to Recent in the Caribbean region. The genus has been recorded from the Oligocene of Peru. At the present time the genus *Adrana* appears to be entirely confined to the New World. One Recent species "*Leda metcalfei*," cited from the Philippine Islands by Hanley and by Sowerby was originally described without information as to locality. We have not noticed it cited in the literature as present in recent collections from the Philippine Islands.

#### KEY TO THE SPECIES OF *Adrana*.

- A. Anterior and posterior dorsal margins forming a nearly straight line
  - a. Umbos a little anterior to the center
    - b. Ventral margin scarcely concave toward ends ..... *elongata*
    - bb. Ventral margin distinctly concave toward ends producing more attenuate terminations ..... *sowerbyana*
  - aa. Umbos central ..... *suprema*
- B. Anterior and posterior dorsal margins forming an obtuse angle at the umbos
  - a. Beaks nearly central
    - b. Branching riblets on anterior dorsal area ..... *tonosiana*
    - bb. Anterior dorsal area without branching riblets ..... *arcuata*
  - aa. Beaks slightly anterior to center
    - c. Surface fully sculptured
      - d. Anterior ventral margin narrowly constricted ..... *taylori*
      - dd. Anterior ventral margin not constricted ..... *crenifera*
    - cc. Posterior dorsal area smooth
      - e. Concentric sculpture of coarse riblets ..... *exoptata*
      - ee. Concentric sculpture fine ..... *penascoensis*

<sup>67</sup> *Adrana aldrichiana* Harris, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 47, April 9, 1895, p. 47, pl. 1, fig. 6 (under the genus *Leda*). "Brazos River, Tex., one and one-half miles below Mosley's Ferry." "Lower Claiborne. Eocene." ——— Harris, *Bull. Amer. Paleo.*, Vol. 6, No. 31, June 30, 1919, p. 71, pl. 25, figs. 20, 21.

<sup>68</sup> See Olsson, A. A., *Bull. Amer. Paleo.*, Vol. 9, Bull. No. 39, 1922, pp. 346-347 (174-175). ——— Maury, *Serv. Geol. e Miner. Brazil, Monogr.* 4, 1924, p. 405. ——— Mansfield, *Florida State Geol. Surv., Bull.* No. 8, 1932, p. 36.

***Adrana arcuata* Sowerby.**

*Laeda arcuata* Sowerby, Conch. Icon., Vol. 18, *Laeda*, September, 1871, sp. 20, pl. 4, fig. 20. "Hab. ....?"

*Nuculana arcuata* Sowerby, Pilsbry & Olsson, *Nautilus*, Vol. 48, no. 4, 1935, p. 118, pl. 6, figs. 2 and 3. Point Ancon, Santa Elena, Ecuador. Also Ecuadorian and Peruvian coasts.

*Type Locality*: Not originally cited. Point Ancon, Santa Elena, Ecuador, here designated as type locality.

*Range*: Coasts of Ecuador and Peru.

Shell elongate with arcuate ventral margin; ornamentation of regular thread-like ribs over the entire surface.

***Adrana crenifera* Sowerby.**

*Nucula crenifera* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 197. "Hab. ad Xipixapi." "It was dredged in sandy mud, at a depth of nine fathoms." —Sowerby, Conch. Illustr., *Nuculae*, 1833, pp. 3, 6, pl. 14, fig. 3. "Xipixapi, Mr. Cuming." —Reeve, Conch. Syst., Vol. 1, 1841, p. 110, pl. 84, fig. 1. —Hanley, Cat. Rec. Biv. Shells, p. 167, 1843, p. 376, 1856?, Suppl. 19, fig. 51, 1846. Xipixapi.

*Leda crenifera* Sowerby, Hanley, Thes. Conch., Vol. 3, *Leda*, 1860, p. 110, pl. 227 (*Nuculidae*, pl. 2), figs. 37 and 38. Xipixapi. —Sowerby, Conch. Icon., Vol. 18, *Laeda*, September, 1871, sp. 21, pl. 4, figs. 21a, 21b. "Hab. Xipixapi."

*Yoldia (Adrana) crenifera* Sowerby, Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 251. Jipijapa, Ecuador.

*Type Locality*: Xipixapi, Ecuador, in 9 fathoms, sandy mud.

*Range*: Known only from the type locality.

Transversely elongated, lanceolate, smooth, with very fine transverse striae, the dorsal margin carinated, the keel crenulated (Hanley).

*Adrana janeiroensis* E. A. Smith<sup>69</sup> from off Rio de Janeiro, Brazil, bears some resemblance to *A. crenifera*. A species of *Adrana* somewhat similar to *A. crenifera* has been mentioned by Olsson<sup>70</sup> as occurring in the Oligocene of Peru, and a species compared to *A. crenifera* was cited by Wolf<sup>71</sup> from the Pliocene of Ecuador. "*Nucula dorbignyi*" described by Philippi<sup>72</sup> from the Tertiary of Chile was compared to *Adrana crenifera*.

The species "*Leda metcalfi*" Hanley is very similar if not identical with *A. crenifera*. It was described by Hanley<sup>73</sup> without locality information. Later, Hanley<sup>74</sup> cited it from the Philippine Islands as did Sowerby<sup>75</sup>. Except for citation of the species in the paper by Faustino<sup>76</sup> we have not noticed a record of it from the Philippine Islands in any recent papers on the fauna of that region.

<sup>69</sup> *Adrana janeiroensis* E. A. Smith, Brit. Mus. (Nat. Hist.) Brit. Ant. ("Terra Nova") Exped., 1910. Nat. Hist. Rept. Zool., Vol. 2, no. 4, Moll. pt. 1, p. 98, pl. 2, fig. 16, 1913: "Off Rio de Janeiro in 40 fathoms. Lat. 22° 56' S., Long. 41° 34' W."

<sup>70</sup> Olsson, A. A., *Bull. Amer. Palco.*, Vol. 17, no. 63, 1931, p. 134 (38).

<sup>71</sup> Wolf, T., Geogr. & Geol. Ecuador, (Leipzig), 1892, p. 631. Pliocene of Uimbi, Ecuador.

<sup>72</sup> *Nucula dorbignyi* Philippi, Los Fos. Terc. i. Cuart. Chile, 1887, p. 188, pl. 41, fig. 10. "Es de Levu i está sobre un gran pedazo de roca dura."

<sup>73</sup> Hanley, S., *Proc. Zool. Soc. London*, 1860, p. 370. "Hab. ———?"

<sup>74</sup> Hanley, S., Thes. Conch., Vol. 3, 1860, expl. to pl. 227 (*Nuculidae*, pl. 2), fig. 34.

<sup>75</sup> Sowerby, II, G. B., Conch. Icon., Vol. 18, *Laeda*, September, 1871, sp. 18, pl. 4, fig. 18.

<sup>76</sup> Faustino, L. A., *Bur. Sci. Philippine Islands, Monogr.* 25, October 30, 1928, p. 18.



***Adrana elongata* Sowerby.**

Plate II, Figure 16.

*Nucula elongata* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 197. "Hab. in Columbia Occidentali." "Dredged in sandy mud, at a depth of twelve fathoms, at Xipixapi." —Sowerby, *Conch. Illustr., Nuculae*, 1833, pp. 3, 6, pl. 14, fig. 2. "Salango, Mr. Cuming." —Müller, *Synop. Test. Viv.*, 1836, p. 190. Original record cited. —Reeve, *Conch. Syst.*, Vol. 1, 1841, p. 110, pl. 84, fig. 2. —Catlow & Reeve, *Conch. Nomencl.*, 1845, p. 53. —Hanley, *Cat. Rec. Bivalve Shells*, p. 167, 1843, p. 376, ?1856, *Suppl.* pl. 19, fig. 50, 1846. [Not accurate figure.]. West Colombia. —d'Orbigny, *Voy. Amér. Mérid.*, Vol. 5, 1846, p. 545. Original record cited.

*Leda elongata* Sowerby, Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 106, pl. 227 (*Nuculidae*, pl. 2), fig. 39. "Salango, W. Columbia." —Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, 1871, sp. 4, pl. 1, fig. 4. "Hab. Salango, West Columbia."

Not *Leda elongata* Treat, *Ann. de Paleol.*, Vol. 22, fasc. 2, 1933, p. 52, pl. 6, fig. 3. "Environs d'Ankitohazo; niveau inférieur." Madagascar. Permo-Triassic.

*Yoldia (Adrana) elongata* Sowerby, Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 251. Coast of Ecuador. —Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 51. Zoogeographical province of Panama.

*Nuculana (Adrana) sowerbyana* d'Orbigny, Strong, Hanna & Hertlein, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 21, no. 10, 1933, p. 118. Acapulco, Mexico.

Not *Nucula (Adrana) sowerbyana* d'Orbigny.

*Type Locality*: Xipixapi, Ecuador, in 12 fathoms, sandy mud.

*Range*: Acapulco, Mexico, to Ecuador.

*Collecting Stations*: Guatemala: 7 miles west of Champerico (197-D-1-2). 14 fathoms, mud bottom; El Salvador: La Libertad (198-D-2). 14 fathoms, mud bottom.

Specimens from three localities appear referable to *Adrana elongata* Sowerby. The application of the specific name *elongata* to this species is somewhat unfortunate because the species is not as elongate in form as is *Adrana sowerbyana*, a similar species. The beaks are more central and the ends much less tapering on *A. elongata* than is the case in *A. sowerbyana*. Another large species of the genus is *Adrana suprema* Pilsbry & Olsson with a length of 107 mm. It differs from *A. elongata* Sowerby in that the beaks are nearly central rather than somewhat anterior as in the species described by Sowerby.

***Adrana exoptata* Pilsbry & Lowe.**

Plate II, Figure 11.

*Leda (Adrana) exoptata* Pilsbry & Lowe, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 84, p. 107, pl. 17, figs. 8 and 9, May 21, 1932. "Mexico: Guaymas, 20 fathoms."

*Type Locality*: Guaymas, Mexico, in 20 fathoms. Type No. 155633 Acad. Nat. Sci. Philadelphia.

*Range*: Guaymas, Sonora, Mexico, to Tangola-Tangola, Oaxaca, Mexico.

*Collecting Stations*: Mexico: 4 miles south-southwest of Maldonado Point (192-D-1). 26 fathoms, mud bottom; Santa Cruz Bay (195-D-21). 18 fathoms, mud bottom; Tangola-Tangola Bay (196-D-17). 4 fathoms, sand bottom.

The shell of this elongate form possesses a smooth band anterior to the posterior carina. The concentric sculpture on the anterior part of the shell becomes obsolete and grades into the smooth area. Some of the specimens in the present collection are slightly upturned at the posterior ex-

tremity of the shells but others barely show this feature and seem to agree almost exactly with *Adrana exoptata* Pilsbry & Lowe. *Adrana newcombi* Angas<sup>77</sup> described from the east side of the isthmus of Panama appears to be a very similar species.

### *Adrana penascoensis* Lowe.

[?] *Yoldia* apparently *electa* A. Adams, Dall, *Amer. Jour. Conch.*, Vol. 7, no. 2, November 2, 1871, p. 154. From the head of the Gulf of California.

*Leda* (*Yoldia*) *lanceolata* Lamarck, Stearns, *Proc. U. S. Nat. Mus.*, Vol. 17 1894, p. 147. Gulf of California.

*Leda* (*Adrana*) *penascoensis* Lowe, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, no. 6, March 21, 1935, p. 18, pl. 1, fig. 8. "Punta Peñasco, Sonora, dredged 10 fathoms."

*Type Locality*: Punta Peñasco, Sonora, Mexico, in 10 fathoms. Type No. 11393 Lowe Coll. in San Diego Soc. Nat. Hist.

*Range*: Gulf of California.

Shell white, with a straw-colored glossy periostracum; strongly compressed beaks much nearer the anterior end. Dorsal line nearly straight, ventral margin curved, anterior and posterior ends about equally angular. Dorsal edges of both valves slightly crenate the entire length. Sculpture of fine concentric lines of growth over the entire surface of both valves, except a narrow portion bordering the posterior dorsal margin, which is entirely smooth. Diameter 37.5 mm., altitude 9.4 mm. (Lowe).

### *Adrana sowerbyana* d'Orbigny.

*Nucula lanceolata* Lamarck, Sowerby, *Conch. Illustr., Nuculae*, 1833, p. 3, pl. 14, fig. 1. "Xipixapi." —Deshayes, ed. of Lamarck's *Anim. s. Vert.*, Vol. 6, 1835, p. 504. [No locality cited]. —Reeve, *Conch. Syst.*, Vol. 1, 1841, p. 110, pl. 84, fig. 1. —Hanley, *Cat. Bivalve Shells, Suppl.* pl. 19, fig. 49, 1846.

Not *Nucula lanceolata* J. Sowerby, *Miner. Conch.*, Vol. 2, 1817, p. 178, pl. 180, fig. 1. "At Bawdsey, Suffolk, in Crag."

Not *Nucula lanceolata* Lamarck, *Anim. s. Vert.*, February-June, 1819, p. 58. "Habite . . . . ."

*Leda sowerbyana* d'Orbigny, *Voy. Amér. Mérid.*, Vol. 5, 1846, p. 544. Reference cited "*Nucula lanceolata*, Sow., 1831, *Gen. of Shells*, no. 17, fig. 1 (non *Lanceolata*, Lamk., 1819)." "Elle a été pêchée par M. Cuming à la côte de Xipixapi, république de l'Équateur."

[?] *Nucula elongata* Sowerby, Valenciennes, *Voy. Venus, Zool., Moll.*, 1846, pl. 23, fig. 4 (two figs.).

*Leda sowerbiana* d'Orbigny, Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 107, pl. 227 (*Nuculidae*, pl. 2), fig. 33. Xipixapi.

*Laeda sowerbyana* d'Orbigny, Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, November, 1871, sp. 1, pl. 1, fig. 1b (only). "*Hab. Xipixapi.*"

*Yoldia* (*Adrana*) *sowerbyana* d'Orbigny, Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 251. "Jipijapa, Ecuador." —Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 51. Panamanian zoogeographical province.

*Type Locality*: Xipixapi, Ecuador.

*Range*: Panama to Ecuador.

A few specimens in the collection appear to be intermediate between *Adrana sowerbyana* and *A. elongata*. The shell of *Adrana sowerbyana* d'Orbigny is similar to *Adrana elongata* Sowerby but is narrower and with more tapering extremities. Hanley believed that the specimen figured by

<sup>77</sup> *Leda* (*Adrana*) *newcombi* Angas, *Proc. Zool. Soc. London*, March 5, 1878, p. 314, pl. 18, figs. 16, 17. "*Hab.* Dredged in Navy Bay, Aspinwall, in 8 fathoms."

Valenciennes as "*Nucula elongata*" Sowerby might probably be referred to *sowerbyana*. The figure given by Valenciennes is somewhat less tapered at the ends than *sowerbyana* but otherwise it is quite similar. Stearns cited *Adrana sowerbyana* (as *L. lanceolata*) from the Gulf of California but Lowe described *Adrana penascoensis* from that region and Pilsbry & Lowe in discussing *Adrana exoptata* stated that *A. elongata* and *A. sowerbyana* occur much further south. *A. scaphoides* Rehder<sup>78</sup> from eastern Colombia is a similar species.

The name *Adrana sowerbyana* presents some complications in regard to nomenclature. *Nucula lanceolata* J. Sowerby was originally described as a fossil from the Pliocene of England in 1817. Lamarck also described under the same name in 1819, a Recent shell without locality information. G. B. Sowerby in the *Genera of Shells* (No. 17, 1825, pl. 102, fig. 1) illustrated a species under the name of *Nucula lanceolata* Lamarck but without information as to locality, while in 1833 G. B. Sowerby Jr. (*Conch. Illustr., Nuculae*, p. 3, pl. 14, fig. 1) illustrated a shell as *Nucula lanceolata* Lamarck with the locality as Xipixapi, which is in western Colombia, and also cited a reference to the figure in the *Genera of Shells*. d'Orbigny in 1846 noticed that the name *Nucula lanceolata* of Lamarck was preoccupied by the same combination of names used by J. Sowerby, hence d'Orbigny proposed for Lamarck's species the new name *Leda sowerbyana* and stated that it was collected at Xipixapi by Cuming. This evidently refers to the shell and locality in *Conchological Illustrations* although in the synonymy d'Orbigny cited the reference to the illustration in the *Genera of Shells*. Hanley in 1860 described "*Leda*" *taylori* from Guatemala and in the synonymy cited the reference to *Nucula lanceolata* of Lamarck and to the figure of *Nucula lanceolata* given by Sowerby in the *Conchological Illustrations* while the illustration of *N. lanceolata* in the *Genera of Shells* is referred by Hanley to *Leda electa* A. Adams from Brazil. Sowerby in 1871 referred the illustration, of *N. lanceolata* Lamarck in the *Genera of Shells* to "*Leda*" *sowerbyana*.

Although d'Orbigny stated that the true *Nucula lanceolata* Lamarck came from New Holland, it does not appear to have been recognized subsequently in that region. The figure in the *Genera of Shells*, which has a distinctly curved anterior dorsal margin and rounded anterior ventral margin, appears to be distinct from the one in the *Conchological Illustrations* which has an almost straight dorsal margin and is attenuated at both ends. We therefore follow Hanley in referring this figure (1833) to the west American *sowerbyana* while the one in the *Genera of Shells* (1825) may be referred to the east American "*Leda*" *electa* A. Adams.

"*Nucula darwini*"<sup>79</sup> described by Philippi from the Tertiary of Chile was compared to "*N. lanceolata* Sow."

### ***Adrana suprema* Pilsbry & Olsson.**

*Nuculana (Adrana) suprema* Pilsbry & Olsson, *Nautilus*, Vol. 48, no. 4, April, 1935, p. 117, pl. 6, fig. 1. "Beach between Port Guanico and the mouth of the Guanico river, Los Santos province, Panama."

*Type Locality*: Beach between Port Guanico and the mouth of the Guanico river, Los Santos province, Panama.

*Range*: Known only from the type locality.

Shell resembling *Adrana elongata* but with the beaks nearly central.

<sup>78</sup>*Adrana scaphoides* Rehder, *Nautilus*, Vol. 53, no. 1, July, 1939, p. 17, pl. 6, fig. 5. "Near Cartagena, Colombia."

<sup>79</sup>*Nucula darwini* Philippi, *Los Fos. Terc. i Cuart. Chile*, 1887, p. 188, pl. 41, fig. 17. From same locality as *Nucula darwini*, that is, "Es de Levu i está sobre un gran pedazo de roca dura."

***Adrana taylori* Hanley.**

*Leda taylori* Hanley, *Proc. Zool. Soc. London*, 1860, p. 370. "Hab. Guatemala."  
 —Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 109, pl. 227 (*Nuculidae*, pl. 2), fig. 35. "Guatemala." —Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, September, 1871, sp. 17, pl. 4, fig. 17. "Hab. Guatemala."

*Type Locality*: Guatemala.

*Range*: Known only from the type locality.

Sowerby (1871) in discussing *Adrana arcuata* stated that "In *Leda taylori*, which resembles this species, there is peculiar narrowness and almost a constriction in the ventral margin at the anterior end not observable in *Laeda arcuata*." *Adrana taylori* is similar to *A. crenifera* Sowerby and *A. electa* A. Adams<sup>80</sup>.

***Adrana tonosiana* Pilsbry & Olsson.**

Plate II, Figure 15.

*Nuculana (Adrana) tonosiana* Pilsbry & Olsson, *Nautilus*, Vol. 48, no. 4, April, 1935, p. 117, pl. 6, fig. 4. "Estero Bucaru, mouth of the Tonosi River, Los Santos, Panamá."

*Type Locality*: Estero Bucaru, Mouth of Tonosi River, Los Santos Province, Panama. Type No. 164025 Acad. Nat. Sci. Philadelphia.

*Range*: Off Mazatlan, Sinaloa, Mexico, to Panama.

*Collecting Stations*: Guatemala: 7 miles west of Champerico (197-D-1-2). 14 fathoms, mud bottom; El Salvador: La Libertad (198-D-1-2). 13-14 fathoms, mud bottom; Nicaragua: Corinto (200-D-19). 12-13 fathoms, mangrove leaves on bottom; Panama: Gulf of Chiriqui (221-D-1-5). 35-40 fathoms, sandy mud bottom.

A large series of specimens dredged off Central America have been referred to *Adrana tonosiana* Pilsbry & Olsson. There seems but little difference between these and young *Adrana arcuata* Sowerby. According to Pilsbry & Olsson *tonosiana* is a smaller form, their specimens not exceeding 26 mm. Some of the specimens in the present collection attain a length of 33 mm. We have assigned these to *tonosiana* chiefly due to the strong and sometimes branching ribbing on the anterior dorsal margin. This was considered by Pilsbry & Olsson to be a characteristic feature of *tonosiana* and not present on *A. arcuata* Sowerby. If this is constantly absent on *A. arcuata* it would seem best to leave *tonosiana* as a valid species, otherwise they are extremely similar. A few irregular radial striae are present on the exterior of the shells in the present collection but these were not mentioned in the description of Pilsbry & Olsson. A single somewhat worn right valve from Sta. 221-D-1-5 has also been assigned to *A. tonosiana* because of the branching ribbing on the anterior dorsal edge. The shell is larger than the type of *A. tonosiana* and has a more pointed posterior end.

*Adrana crenifera* Sowerby is somewhat similar in form but the dorsal margin has a greater slope from the beak and the edge of the posterior ridge is said to be angular and decidedly crenulated.

**Genus *Yoldia* Möller.**

*Yoldia* Möller, *Naturhist. Tidsskrift*, IV (1), 1842, p. 91, also *Index Moll. Groenlandiae*, 1842, p. 18. Species cited: "*Y. arctica*, *Nucula arctica* Gray" and "*Y. angularis* nob., *Nuc. myalis* Couth.?" —S. A. Miller, *North Amer. Geol. and Palaeo.*, (Cincinnati, Ohio), 1889, p. 516. "Type *Y. myalis*," fig. 935.

<sup>80</sup> *Leda electa* A. Adams, See Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 109, pl. 227 (*Nuculidae*, pl. 2), figs. 40 and 41. "Santos, Brazil." —Sowerby, *Conch. Icon.*, Vol. 18, *Laeda*, February, 1871, sp. 2, pl. 1, figs. 2a, 2b. "Hab. Santos Brazil."

———Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, June 15, 1898, p. 858. "Type. ——*Yoldia hyperborea* Torrell=*Yoldia arctica* Möller (not Gray)." ——Cossmann, *Act. Soc. Linn. Bordeaux*, Vol. 66 (Conch. Neog. Aquit., Vol. 2, Livr. 1), 1912, p. 113. Genotype: *L. hyperborea* Loven. ——Gardner, Geol. Surv. Maryland. Upper Cretaceous, 1916, p. 518. "Type. ——*Yoldia arctica* Gray." ——Woodring, *Carnegie Inst. Washington, Publ.* 366, 1925, p. 21. Type: "*Nucula arctica* Möller not Gray (= *Nucula myalis* Couthouy)." ——Stewart, *Acad. Nat. Sci. Philadelphia, Spec. Publ.* No. 3, 1930, p. 59. Type designation of Verrill & Bush accepted. ——Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 126. Type: *Nucula arctica* Gray.

Type (designated by Gardner): *Nucula arctica* Gray. [Suppl. to Ap. Parry's First Voy., 1819-1820, p. 241, 1824. ——Also illustrated by Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, pl. 1, figs. 10, 11 (figures copied from Mossevich, *Acad. Sci. Union Republ. Soviet Socialist.*, Livr. 19, 1928, pl. 1, figs. 1 and 3). Circumboreal].

Somewhat similar to *Nuculana* but with thinner, subovate shell, slightly rostrate, usually gaping posteriorly; exteriorly sculptured by growth-lines or concentric striae; hinge consisting of two subequal series of small chevron-shaped teeth; resilium-pit large, symmetrically underlapping both rows of teeth; pallial sinus deep and wide, the apex broadly U-shaped.

There is considerable disagreement among various authors as to the designation of the type species of *Yoldia*. Grant & Gale have given a discussion of the problem. The designation of *Yoldia myalis* Couthouy by Miller in 1889 is not strictly valid due to the fact that in the original list of species under *Yoldia* it was cited as "*Nuc. myalis* Couth.?" and is thus a *species inquirenda* and not acceptable under the present rules of nomenclature. The interpretation of the type of *Yoldia* as indicated by Grant & Gale appears to be the correct one, and the type here accepted is *Nucula arctica* Gray. *Yoldia* probably ranges from Eocene to Recent, although it has been recorded from the Carboniferous. Several species of the genus *Yoldia* have been described from the Eocene of Western North America.

*Microyoldia* Verrill & Bush<sup>81</sup>, with the type *M. regularis* Verrill, has not been recorded from tropical west American waters.

### Subgenus *Katadesmia* Dall.

*Katadesmia* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1898, p. 379. Sole species: *Yoldia (Katadesmia) vincula* Dall. ——Thiele, *Handbuch Syst. Weichtierkunde*, Teil 3, 1934, p. 790. *Y. (K.) vincula* Dall, cited.

Type (by original designation and by monotypy): *Yoldia (Katadesmia) vincula* Dall.

Southern species with well-defined functional opisthodontic ligament.

### *Yoldia (Katadesmia) vincula* Dall.

*Yoldia (Katadesmia) vincula* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 379, pl. 5, fig. 5. U. S. S. Albatross station 3360, "in 1672 fathoms, sand, Gulf of Panama, bottom temperature 42° F." Also at stations 3354 and 3361, in 322 fathoms, and in 1471 fathoms.

*Yoldia vincula* Dall, Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 38. Panama.

Type Locality: Gulf of Panama, in 1,672 fathoms, sand. Type No. 122,903 U. S. Nat. Mus.

Range: Gulf of Panama.

<sup>81</sup> *Microyoldia* Verrill & Bush, *Amer. Jour. Sci.*, Ser. 4, Vol. 3, January, 1897, p. 56. "Type *M. regularis* (V.)," figs. 5 and 6 (p. 60). ——Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, 1898, p. 860. Type: *Microyoldia regularis* Verrill, p. 860, pl. 78, figs. 5 and 6.

The species is notable for its pale color and brilliant polish (Dall). Shell with the general form of *Sanguinolaria rosea*; hinge with 15 anterior and about 25 posterior teeth.

### Subgenus *Megayoldia* Verrill & Bush.

*Megayoldia* Verrill & Bush, *Amer. Jour. Sci.*, Ser. 4, Vol. 3, January, 1897, p. 55. "Type *M. thraciaeformis* (Storer)," fig. 17. —Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, 1898, p. 859. Type: *Megayoldia thraciaeformis* (Storer).

Type (by original designation): *Megayoldia thraciaeformis* (Storer). [= *Leda thraciaeformis* Storer, *Boston Jour. Nat. Hist.*, Vol. 2, 1838, p. 122, text fig. ". . . from the stomach of a Platessa —the dentata of Mitchill —called by our fishermen, *Sand dab*: —this fish was caught off Provincetown, Cape Cod, in about thirty fathoms of water." —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 27, pl. 5, fig. 1. Arctic Ocean to Oregon and Puget Sound. Also Atlantic].

Broad, compressed form, with a very blunt, indefinite, postero-dorsal rostrum, and with a low radial ridge, ending in a postero-ventral marginal lobe. The chondrophore is remarkably large and strong, concave, striated within, and projects much within the margin of the hinge-plate. The pallial sinus is large and deep. Ligament external, strongly developed (from Verrill & Bush).

*Megayoldia* is known in the Oligocene and probably occurs from Eocene to Recent. *Yoldia emersoni* Dall<sup>82</sup> described from the Eocene of Alaska may belong to this subgenus. Makiyama<sup>83</sup> has discussed the relationships of several Japanese species belonging to *Megayoldia*.

### *Yoldia (Megayoldia) martyria* Dall.

*Yoldia martyria* Dall, *Nat. Hist. Soc. Brit. Columbia, Bull.* No. 2, January, 1897, p. 9, pl. 2, fig. 15. "Puget Sound, 35-135 fms.; Gulf of California off the Island of San Pedro Martir, in 65 fms.; U. S. Fish Commission steamer Albatross." —Dall, Checklist Rec. Biv. Moll. (Southwest Museum), 1916, p. 11. Kasa-an Bay, Alaska, to Gulf of California. —Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 13. Kasa-an Bay, Alaska, to Gulf of California. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.* Vol. 1, 1924, p. 29, pl. 39, fig. 11. Type locality and range same as cited by Dall. —Keen, Check List West North Amer. Mar. Moll. (Stanford Univ. Calif.), 1937, p. 27. Range: Lat. 23°-55° N.

Type Locality: (According to I. S. Oldroyd), off San Pedro Martir Island, Gulf of California. Type in U. S. Nat. Mus.

Range: Kasa-an Bay, Alaska, to the Gulf of California.

Shell olive-greenish, smooth, nearly equilateral; posterior end roundly pointed, compressed and slightly recurved; hinge with 21 anterior and 17 posterior teeth.

### Subgenus *Orthoyoldia* Verrill & Bush.

*Orthoyoldia* Verrill & Bush, *Amer. Jour. Sci.*, Ser. 4, Vol. 3, 1897, p. 55. "Type *Orthoyoldia scapina* (Dall)." —Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, 1898, p. 859. Type: *Orthoyoldia scapina* (Dall).

Type (by original designation): *Orthoyoldia scapina* (Dall). [= *Yoldia scapana* Dall, *Proc. U. S. Nat. Mus.*, Vol. 12, 1889, p. 254, pl. 13, fig.

<sup>82</sup> *Yoldia emersoni* Dall, Harriman Alaska Exped., Vol. 4, 1910, p. 104, pl. 9, fig. 8. "Upper beds, 3373." Beds near the camp on the eastern side of Chichagof Cove. Upper beds of Stepovak Series. Eocene.

<sup>83</sup> Makiyama, J., *Mem. Coll. Sci. Kyoto Imper. Univ.*, Ser. B, Vol. 10, no. 2, 1934, pp. 130-132.

6. U. S. Fish Commission station 2762, "east of Rio Janeiro, in 59 fathoms, mud; bottom temperature 57°F."].

Shell oblong, gaping, blunt or rounded at both ends, without a distinct rostrum; no carina. Pallial sinus large and broad. Teeth numerous in both series (Verrill & Bush).

The shells of *Orthoyoldia* are soleniform or elongate-elliptic in shape.

*Orthoyoldia* is known from the Miocene<sup>84</sup> of the Caribbean region. It is now living in that region and is represented by at least one species in tropical west American waters.

### ***Yoldia (Orthoyoldia) panamensis* Dall.**

*Yoldia (Orthoyoldia) panamensis* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 380. U. S. S. *Albatross* station 3354, "Gulf of Panama, in 322 fathoms, mud, bottom temperature 46° F." Also at station 3355, in 182 fathoms.

*Yoldia panamensis* Dall, Zetek, *Rev. Nueva*, Nos. 1 & 2, 1918, p. 38. Panama.

*Type Locality*: Gulf of Panama, in 322 fathoms, mud. Type No. 122,900 U. S. Nat. Mus.

*Range*: Gulf of Panama.

The shell of this species is small, narrow, elongate, and very inequilateral; resilium small, vertical, triangular and wholly internal; no visible external ligament; hinge with 18 anterior and 52[?25]-27 posterior teeth.

### Subgenus ***Yoldiella*** Verrill & Bush.

*Yoldiella* Verrill & Bush, *Amer. Jour. Sci.*, Ser. 4, Vol. 3, January, 1897, p. 55. "Type *Yoldiella lucida* (Loven)," figs. 3, 4, 11, 14. ———Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, 1898, p. 861. Type: *Yoldiella lucida* (Lovén).

*Type* (by original designation): *Yoldiella lucida* (Lovén). [= *Yoldia lucida* Lovén, *K. Vet. Akad. Förh.*, 1846 (Index Moll. Lit. Scandinaviae occid. Habit.), p. 34. "Boh.-Finn." Illustrated as *Portlandia lucida* Loven, by Sars, *Bid. Kundsk. Norg. Ark. Fauna. I. Moll. Reg. Arct. Norvegiae*, 1878, p. 37, Tab. 4, figs. 8a, 8b. West Coast of Norway in 20-650 fathoms. Also in Arctic and north Atlantic. ———Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, 1898, p. 861, pl. 77, fig. 2; pl. 80, fig. 3 (as *Yoldiella lucida*)].

This group includes a large number of small, mostly deep-sea species, with glossy, iridescent, ovate, and usually wedge-shaped shells, nearly always having a slight postero-ventral sinuosity, which feebly defines an obscure, blunt, rostral region, without any definite carination. The shells do not gap, but close tightly, except that at the rostral angle of some species there may be a slight divergence. The internal cartilage, which is often relatively large, occupies a simple notch, which interrupts the hinge margin more or less completely and generally shows externally in a dorsal view; the notch usually terminates within on the inner or inferior surface of the hinge-plate, and is often bounded within by a slight ridge. A weak external ligament is present on the postero-dorsal margin. A relatively small, pallial sinus has been observed in several of the species, but is usually indistinct. The siphon tubes, as observed in a few of the species, are slender and united for more than half their length. (Verrill & Bush).

<sup>84</sup> See *Yoldia (Orthoyoldia) ovalis* Gabb, Woodring, *Carnegie Inst. Washington, Publ.* 366, 1925, p. 22, pl. 1, figs. 20, 21. Bowden, Jamaica; Miocene. *Yoldia bocasensis* Olsson (*Bull. Amer. Paleo.*, Vol. 9, Bull. No. 39, 1922, p. 348 (176), pl. 31 (28), figs. 21, 22. "Gatun Stage: Bocas del Toro") from the Miocene of Panama, is a similar species.

***Yoldia (Yoldiella) cecinella* Dall.**

*Yoldia cecinella* Dall, *Proc. U. S. Nat. Mus.*, Vol. 52, December 27, 1916, p. 399. "Station 2823, off La Paz, Gulf of California, in about 26 fathoms."  
 —Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 14. Aleutian Islands to Gulf of California. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 34. Type locality and range same as cited by Dall. —Keen, *Check List West North Amer. Mar. Moll.* (Stanford University Press), 1937, p. 27. Lat. 23°-55° N.

*Type Locality*: Off La Paz, Lower California, Mexico, in about 26 fathoms. Type No. 211,424 U. S. Nat. Mus.

*Range*: Aleutian Islands to the Gulf of California.

Shell minute, polished, smooth, nearly equilateral, the margins arcuate above and below, the anterior end rounded, the posterior more pointed and slightly longer; beaks low and inconspicuous, with neither lunule nor escutcheon indicated; hinge with 6 or 7 minute teeth on each side of the subumbonal, very small resilifer. Length, 5 mm.; height, 2.6 mm.; diameter, 1.5 mm. (Dall).

***Yoldia (Yoldiella) chilénica* Dall**

*Yoldia (Yoldiella) chilénica* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 380. U. S. S. *Albatross* station 2781 "on the southern coast of Chile (Lat. 51° 52' S.), in 348 fathoms, mud, bottom temperature 50° F." Also at station 2782, in 258 fathoms.

*Type Locality*: Southern coast of Chile (Lat. 51° 52' S.), in 348 fathoms, mud. Type No. 96,923 U. S. Nat. Mus.

*Range*: Southern coast of Chile.

This species has not been illustrated but according to Dall it has somewhat the appearance of young *Yoldia thraciaeformis*. Hinge with 19 anterior and 17 posterior teeth.

***Yoldia (Yoldiella) dicella* Dall.**

*Yoldia (Yoldiella) dicella* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 382. U. S. S. *Albatross* station 3418, "off Acapulco, Mexico, in 660 fathoms, sand, bottom temperature 39° F."

*Type Locality*: Off Acapulco, Mexico, in 660 fathoms, sand. Type No. 122,917 U. S. Nat. Mus.

*Range*: Known only from the type locality.

This is said to be a "spade-shaped" little species quite distinct from others of the genus in west American waters. Hinge with about 10 anterior and 15 posterior teeth.

***Yoldia (Yoldiella) granula* Dall.**

*Yoldia (Yoldiella) granula* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 382. U. S. S. *Albatross* station 2778, "in Magellan Straits, in 61 fathoms, bottom temperature 47°.9 F."

*Type Locality*: Magellan Straits, in 61 fathoms. Type No. 110,693 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell minute, oval, equilateral, moderately tumid, smooth, covered with a polished straw-colored periostracum; interior porcellanous, with a very slight pallial sinus and smooth margins; hinge line with about six teeth on



either side of a well-developed resilium, the most anterior tooth of all a little more distant and notably larger than any of the others. Length, 1.7; alt. 1.2; max. diam. 1.0 mm. (Dall).

***Yoldia (Yoldiella) indolens* Dall.**

*Yoldie*[a] (*Yoldiella*) *indolens* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1898, p. 381. U. S. S. *Albatross* station 2784, "on the southern coast of Chile, in 194 fathoms, mud, bottom temperature 51°.9 F." Also at station 2785, in 122 fathoms.

*Type Locality*: Southern coast of Chile, in 194 fathoms, mud. Type No. 122,740 U. S. Nat. Mus.

*Range*: Southern coast of Chile.

Apparently no illustration has been given of this species. According to Dall it resembles *Yoldia chilensis* but is more inflated. Hinge with about a dozen teeth on each side of the pit for the resilium.

***Yoldia (Yoldiella?) infrequens* Dall.**

*Yoldia (Yoldiella?) infrequens* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 381. U. S. S. *Albatross* station 2784, "in 194 fathoms, mud, off the coast of southern Chile, bottom temperature 51°.9 F." Also at station 2783, in 122 fathoms.

*Type Locality*: Off the coast of southern Chile, in 194 fathoms, mud. Type No. 110,692 U. S. Nat. Mus.

*Range*: Off the southern coast of Chile.

Shell very small, callistaeform, tumid; both ends of shell evenly rounded; concentrically striated; hinge with about 9 anterior and 13 posterior teeth. Length, 4.4 mm.; height, 3.5 mm.; maximum diameter, 2.0 mm.

***Yoldia (Yoldiella) leonilda* Dall.**

*Yoldia (Yoldiella) leonilda* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 382. U. S. S. *Albatross* station, 3360, "Gulf of Panama, in 1672 fathoms, sand, bottom temperature 42° F."

*Yoldia leonilda* Dall, *Zetek, Rev. Nueva*, Nos. 1 & 2, 1918, p. 38. Panama.

*Type Locality*: Gulf of Panama, in 1,672 fathoms, sand. Type No. 122,909 U. S. Nat. Mus.

*Range*: Gulf of Panama.

Shell small, oval, smooth, white; hinge with 12 anterior and 14 posterior teeth.

***Yoldia (Yoldiella?) mantana* Dall.**

*Yoldia (Yoldiella?) mantana* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 381. U. S. S. *Albatross* station 2792, "in 401 fathoms, mud, off Manta, Ecuador, bottom temperature 42°.9 F."

*Type Locality*: Off Manta, Ecuador, in 401 fathoms, mud. Type No. 122,756 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell small, elongate-oval, white, nearly equilateral, with a pale yellowish periostracum; surface mostly smooth but with a few irregular concentric striae; hinge with about 9 anterior and 10 or 11 posterior teeth. Length, 5.0 mm.; height, 3.2 mm.; maximum diameter, 2.5 mm.

Genus **Cyrilla** A. Adams.

*Huxleyia* A. Adams, *Ann. & Mag. Nat. Hist.*, Ser. 3, Vol. 5, April, 1860, p. 303. Sole species: *Huxleyia sulcata* A. Adams. See also p. 432.

Not *Huxleyia* Bowerbank. Dall (1898), cited the use of the name *Huxleyia* by Bowerbank but we have not noticed a citation to the original reference.

Not *Huxleya* Dyster, *Quart. Jour. Micr. Soc.*, Vol. 6, 1858, p. 260.

*Cyrilla* A. Adams, *Ann. & Mag. Nat. Hist.*, Ser. 3, Vol. 5, June, 1860, p. 478. "In a former paper I gave the name *Huxleyia* to a new genus of bivalve Mollusca. Should, however, this name have been already used, which is not improbable, *Cyrilla* might be substituted for it." —A. Adams, *Ann. & Mag. Nat. Hist.*, Ser. 3, Vol. 9, 1862, p. 295. —A. Adams, *Journ. de Conchyl.*, Vol. 16, 1868, p. 41. —Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, Pt. 4, 1898, p. 601. Type: *H. sulcata* A. Adams.

Type (by monotypy): *Huxleyia sulcata* A. Adams. [*Ann. & Mag. Nat. Hist.*, Ser. 3, Vol. 5, 1860, p. 303. "Hab. 16 miles from Mino-Sima, Straits of Korea; dredged from 63 fathoms." —A. Adams, *Journ. de Conchyl.*, Vol. 16, 1868, p. 42, pl. 4, fig. 2. Original locality cited.

Shell suborbicular, minute, exteriorly smooth or with simple sculpture; pallial line entire; fossette for ligament enlarged and rounded; anterior cardinal teeth reduced, posterior series of teeth well developed; interior of shell not nacreous.

*Nucinella* Wood<sup>85</sup> with the type *Nucula miliaris* Deshayes from the Eocene of the Paris Basin, is a related genus. The name *Pleurodon* Wood was replaced by *Nucinella* Wood due to the earlier use of *Pleurodon* by Harlan. *Pleurodon microdus* Boettger, *P. cinctus* von Koenen, *P. dobergensis* Lienenklaus and *P. zinnendorfi* Zilch<sup>86</sup> all referred to *Pleurodon*, have been described from the Oligocene of Germany and the genus has been cited from Eocene to Recent. *Pleurodon gunteri* Mansfield<sup>87</sup> has been described from the Miocene, and *P. woodii* Dall<sup>88</sup> from the Miocene and Pliocene of Florida, and *P. adamsii* occurs in the waters off the coast of Florida. E. A. Smith<sup>89</sup> recorded a species living off the Cape of Good Hope, under the name of *Nuculina ovalis* Wood. It is probably a distinct species from the one originally described under that name from the Crag, Pliocene of England. Jeffreys<sup>90</sup> cited *Nucinella ovalis* Wood from the Strait of Korea in 40 fathoms but probably that record can be referred to some similar species inhabiting the North Pacific. Lamy described "*Nucinella Serrei*"<sup>91</sup> from Brazil, and Cotton & Godfrey have recently added a new species, "*Pleurodon hedleyi*," to the fauna of South Australia. Species of *Cyrilla* are also known off the coasts of New Zealand<sup>92</sup> and Japan as well as off North and Central America.

<sup>85</sup> *Nucinella* Wood, *Palaeontogr. Soc., Monogr. Crag. Moll.*, Pt. 2, 1850, p. 72. Species cited: *Nucula miliaris* Deshayes. In the synonymy of which was included *Pleurodon ovalis* S. Wood, 1840. *Nucinella* to replace *Pleurodon* Wood, 1840 [not *Pleurodon* Harlan, *Jour. Acad. Nat. Sci. Philadelphia*, Vol. 6, 1831, p. 284]. —Schenck, *Jour. Paleo.*, Vol. 13, no. 1, January, 1939, p. 39. "*Nucinella* Wood, 1850 (genotype, *N. miliaris* (Deshayes), from the Eocene of the Paris Basin)" [= *Nucula miliaris* Deshayes, *Descript. Coq. Foss. env. Paris*, Vol. 1, Livr. 15, 1829, p. 235, pl. 36, figs. 7, 8, 9].

<sup>86</sup> *Pleurodon zinnendorfi* Zilch, *Arch. f. Molluskenkunde*, Bd. 69, No. 5-6, November, 1937, p. 250, figs. 1a, 1b. "In den mittelloligozänen Meeressanden des Mainzer Beckens, am Welschberg bei Waldböckelheim."

<sup>87</sup> *Pleurodon gunteri* Mansfield, *Florida State Geol. Surv., Bull.* No. 8, 1932, p. 38, pl. 2, figs. 4 and 6. Vaughan Creek, Walton County, Florida. Upper Middle Miocene.

<sup>88</sup> *Pleurodon woodii* Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, pt. 4, 1898, p. 600, pl. 24, fig. 10. "Pliocene marls of the Caloosahatchie, Florida." —Mansfield, *Florida State Geol. Surv., Bull.* No. 8, 1932, p. 37, pl. 2, figs. 1 and 3. *Cancellaria* zone—borrow pit, Jackson Bluff, Leon County, Florida; upper Miocene.

<sup>89</sup> *Nuculina ovalis* (S. Wood), E. A. Smith, *Sci. Rept. Voy. Challenger, Zool.*, Vol. 13, 1885, p. 230, pl. 19, figs. 1, 1b. "Simon's Bay, Cape of Good Hope, in 15 to 20 fathoms."

<sup>90</sup> Jeffreys, J. G., *Jour. Linn. Soc. London*, Vol. 14, 1879, p. 420.

<sup>91</sup> *Nucinella serrei* Lamy, *Bull., Mus. Nat. d'Hist. Nat. (Paris)*, Vol. 18, no. 7, 1912, p. 432, figs. 1, 2, 3. Brazil.

<sup>92</sup> *Pleurodon maorianus* Hedley, *Rec. Australian Mus.*, Vol. 5, no. 2, January 28, 1904, p. 87, fig. 14. "from 5 fathoms off Anchor Island, Dusky Sound, New Zealand."

Two generic names *Cyrrilona* and *Cyrrillista* have been proposed by Iredale<sup>93</sup> for austral species formerly referred to *Cyrrilla* or *Nuculina*. *Diabolica Jousseume*<sup>94</sup> is referable to *Cyrrilla* as indicated by Thiele.

Lamy<sup>95</sup> has reviewed many of the species referred to *Pleurodon* and *Nucinella*.

#### KEY TO THE SPECIES OF *Cyrrilla*.

- A. Lateral tooth short, ligamentary pit large.....*munita*  
 B. Lateral tooth long, ligamentary pit small.....*subdolosus*

#### *Cyrrilla munita* Carpenter in Dall.

*Cyrrilla munita* Carpenter, Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, pt. 4, April, 1898, p. 602. "From thirty fathoms off Catalina Island, California." —Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 14 (under the genus *Pleurodon*). Santa Barbara Islands to the Gulf of California. —Schenck, *Jour. Paleol.*, Vol. 13, no. 1, January, 1939, p. 39, pl. 6, figs. 14 and 15. Type localities of *Cyrrilla munita* and *Nucula petriola* cited.

*Nucula petriola* Dall, *Proc. U. S. Nat. Mus.*, Vol. 52, December 27, 1916, p. 395. "Off Santa Rosa Island, California, in 53 fathoms, mud." —I. S. Oldroyd, *Stanford Univ. Publ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 12. Type locality cited.

*Nuculina munita* Carpenter, Lamy, *Bull. Mus. Nat. d'Hist. Nat. (Paris)*, Vol. 18, no. 7, 1912, pp. 430, 431. Earlier records cited.

*Pleurodon munitum* (Carpenter) Dall, I. S. Oldroyd, *Stanford Univ. Publ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 36. Locality and range same as cited by Dall.

*Nucinella munita* [Carpenter in Dall], Keen, Check List West North Amer. Mar. Moll., (Stanford Univ., Calif.), 1937, p. 23, Lat. 23°-34° N.

*Type Locality*: Off Catalina Island, California, in 30 fathoms. Type of *Nucula petriola*, No. 271,416 U. S. Nat. Mus.

*Range*: Santa Rosa Island, California to ? Lat. 34° S.

A small rounded-quadrate shell with a large fossette.

#### Subgenus *Neopleurodon* Hertlein & Strong, nov.

*Type*: *Pleurodon subdolosus* Strong & Hertlein.

Shell minute, suborbicular; exteriorly smooth or with simple sculpture; pallial line entire; hinge plate well developed with teeth forming a gentle arc; a long lateral tooth present in right valve; interior not nacreous.

*Neopleurodon* differs from *Cyrrilla* in the more even arcuate series of teeth and in the very small area for the ligament, and longer lateral tooth.

Judging from the illustration, *Pleurodon ovalis* Wood<sup>96</sup> from the Pliocene of England may belong to this subgenus, as may "*Pleurodon hedleyi*" Cotton & Godfrey<sup>97</sup>.

<sup>93</sup> Iredale, T., *Rec. Australian Mus.*, Vol. 17, no. 4, September 4, 1929, pp. 160, 188. *Cyrrilona*, "Type *Cyrrilla dalli* Hedley." *Mem. Australian Mus.*, Mem. 4, Vol. 1, pt. 5, July 29, 1902, p. 296, fig. 44. "off Port Kembla, in 63-75 fathoms, and off Cape Three Points in 41-50 fathoms." *Cyrrillista*, "Type *Nuculina concentrica* Verco." Illustrated by Cotton & Godfrey, *Moll. South Australia*, Pt. 1, 1938, p. 56, fig. 38.

<sup>94</sup> *Diabolica diabolica* Jousseume, *Le Naturaliste*, Ann. 19, (Ann. 11, Ser. 2), no. 257, November 15, 1897, p. 265. Sole species: *Diabolica diabolica* Jousseume. No locality cited. —Lamy, *Mem. Inst. Egypt*, Vol. 37, 1938, p. 8, fig. 1 (as *Nucinella (Cyrrilla) diabolica*). Gulf of Akaba.

<sup>95</sup> Lamy, E., Sur le Genre *Pleurodon* ou *Nucinella* S. Wood, avec description d'une espèce nouvelle, *Bull. Mus. Nat. d'Hist. Nat. (Paris)*, Vol. 18, no. 7, 1912, pp. 429-433. See also Lamy, E., *Journ. de Conchyl.*, Vol. 60, no. 2, December 15, 1912, pp. 108, 109 (footnote).

<sup>96</sup> *Pleurodon ovalis* Wood, *Mag. Nat. Hist.*, New Ser., Vol. 4, 1840, p. 230, Suppl. pl. 13, fig. 1. "Coralline crag Ramsholt and Sutton." —See illustration by Wood, *Palaeontogr. Soc.*, Monogr. Crag. Moll., Pt. 2, 1850, p. 72, pl. 10, figs. 4a, 4b, 4c.

<sup>97</sup> *Pleurodon hedleyi* Cotton & Godfrey, *Moll. South Australia*, Pt. 1. Handbook Flora and Fauna of South Australia, issued by South Australian Brit. Sci. Guild, Adelaide, 1938, p. 57, fig. 39. "100 fathoms, 40 miles south of Cape Wiles, South Australia."

**Cyrella (Neopleurodon) subdolos** Strong & Hertlein.

*Pleurodon subdolos* Strong & Hertlein, *Proc. Calif. Acad. Sci.*, Ser. 4, Vol. 22, no. 6, December 31, 1937, p. 162, pl. 35, figs. 14, 18, 19. "Lat. 23° 12' N., Long. 106° 29' W., dredged in 12 fathoms, about five miles west of Mazatlan, Sinaloa, Mexico."

*Type Locality*: Off Mazatlan, Mexico, in 12 fathoms. Type No. 6,970 Calif. Acad. Sci. Paleo. Type Coll.

*Range*: Known only from the type locality.

The more regularly oval shell, persistent dark epidermis, and different hinge are features separating *Cyrella subdolos* from *C. munita* (Carpenter) Dall. *Cyrella adamsi* Dall<sup>98</sup> from the Straits of Florida is a somewhat similar species but the hinge is different.

Genus **Malletia** Desmoulin.

*Malletia* Desmoulin, *Act. Soc. Linn. Bordeaux*, Vol. 5, February 15, 1832, p. 85. —Stoliczka, *Mem. Geol. Surv. India. Palaeont. India*. Cret. Fauna South. India, Vol. 3, 1871, pp. XX, 321. "Type, *M. chilensis*, Desm." —Verrill & Bush, *Amer. Jour. Sci.*, Ser. 4, Vol. 3, January, 1897, p. 56. "Type *Malletia chilensis* Desmoulin." —Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, 1898, p. 873. Type: *Malletia chilensis* Desmoulin. —Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, pt. 4, 1898, p. 581. "Type *M. norrisii* (Sby.) = *M. chilensis* Desm." —Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 383. Type: *M. chilensis* Desmoulin. —Cossmann & Peyrot, *Act. Soc. Linn. Bordeaux*, Vol. 66 (Conch. Neog. Aquit., Vol. 2, Livr. 1), 1912, p. 121. Genotype: *M. chilensis* Desmoulin. —Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 132. Type: *M. chilensis* Desmoulin. —Prashad, Siboga Exped., Mon. 53c, Lamell., 1932, p. 25. Type: *Malletia chilensis* Desmoulin.

*Solenella* Sowerby, *Proc. Zool. Soc. London*, for 1832 (issued March 13, 1833), p. 197. Sole species: *Solenella norrisii*. Valparaiso, Chile, in soft mud, at from 14 to 45 fathoms.

*Pseudomalletia* Fischer, *Man. de Conchyl.*, 1886, p. 987. Species cited: *P. obtusa* Sars and *P. transversa* Ponzi.

*Type* (designated by Stoliczka): *Malletia chilensis* Desmoulin.

Shell oval, compressed, smooth or concentrically furrowed, epidermis olive; ligament external, elongated, prominent; hinge with an anterior and posterior series of fine sharp teeth; interior subnacreous; pallial sinus large and deep; anterior adductor scar giving off a long oblique pedal line (Tryon: *Struct. and Syst. Conch.*)

The shell of *Malletia* s.s. is oblong elliptical, blunt posteriorly and without a definite rostrum or carination. The carinated and rostrate species with strong concentric sculpture can in many cases be referred to *Neilo* H. & A. Adams. The absence of a lunule, escutcheon and distinct rostrum serve to separate *Malletia* from *Yoldia*. A characteristic feature of the hinge of *Malletia* is that the posterior series of teeth are often more than twice as numerous as the anterior series.

*Malletia* has been recorded from upper Cretaceous<sup>99</sup> to Recent. It is primarily a Magellanic genus which is said to have reached the northern

<sup>98</sup> *Pleurodon adamsi* Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, pt. 4, April, 1898, p. 601, pl. 24, fig. 9. "Dredged seven miles east of Fowey Rocks, Straits of Florida."

<sup>99</sup> *Malletia gracilis* Wilckens, *Wiss. Ergeb. Schwed. Südpolar-Exped.*, 1901-1903, Bd. 3, Lief. 12, 1910, p. 25, Taf. 2, fig. 4. Seymour Island, Antarctica; Cretaceous. The shape of this species is similar to that of *M. chilensis* Desmoulin.

*Malletia ornata* Sowerby has been reported from Patagonia in beds referred to the upper Cretaceous, also in beds referred to the Eocene by von Ihering (*An. Mus. Nac. Buenos Aires*, Ser. 3, Vol. 7, 1907, pp. 4, 228). The species bears a resemblance to *M. australis* Quoy & Gaimard of New Zealand. Powell (Shellfish of New Zealand, 1937, p. 55), referred *M. australis* to *Neilo* which he considered to be of generic status.

hemisphere during the Oligocene or Miocene, but the genus appears to be present in the Eocene of California.

One of the largest species of *Malletia* is *M. gigantea*<sup>100</sup> which occurs at Kerguelen Island in the south Atlantic. The size is noteworthy, the type specimen is 62 mm. in length. The posterior end of *M. gigantea* is expanded in a manner somewhat resembling *Yoldia thraciaeformis*. E. A. Smith mentioned that the animal of *Yoldia subaequilateralis*<sup>101</sup> "resembles that of *Solenella gigantea* in all respects excepting that the edge of the foot is bluntly serrated or scalloped."

### *Malletia (Malletia) chilensis* Desmoulins.

*Malletia chilensis* Desmoulins, *Act. Soc. Linn. Bordeaux*, Vol. 5, January 15, 1832, p. 85, pl. 1, figs. 1-8. Valparaiso, Chile, in 14 to 45 fathoms (according to Dall). —H. & A. Adams, *Gen. Rec. Moll.*, Vol. 2, 1858, p. 549, pl. 126, figs. 6, 6a. —Chenu, *Man. de Conchyl.*, Vol. 2, 1862, p. 181, fig. 913. —Kobelt, *Illustr. Conchylienbuch*, Bd. 2, Lief. 10-11, 1881, p. 372, pl. 109, fig. 3. Chile. —Tryon, *Struct. and Syst. Conch.*, Vol. 3, 1884, p. 249, pl. 126, fig. 34 (on expl. to pl. 126 as *Yoldia (Malletia) chilensis*). Valparaiso, Chile. —Fischer, *Man. de Conchyl.*, Fasc. 10, 1886, p. 987, pl. 17, fig. 22. —Verrill & Bush, *Amer. Jour. Sci.*, Ser. 4, Vol. 3, 1897, p. 56, fig. 9 (on p. 60). —Stempell, *Zool. Jahrb.*, Suppl. Bd. 4 (Fauna chilensis, Bd. 1), Heft 2, July 1, 1898, p. 343 (and following pages), pl. 22, figs. 2, 3, 4, 9, 12; pl. 23, figs. 13, 14, 15, 16, 17; pl. 24, fig. 32 (anatomy). —Stempell, *Zool. Jahrbuch.*, Suppl. Bd. 5 (Fauna Chilensis, Bd. 2), 1902, p. 219. Harbor of Coquimbo; Talcahuano, in 10 fathoms; Calbuco, in 10 fathoms. —Dall, *Proc. U. S. Nat. Mus.*, Vol. 37, 1909, p. 251. Coquimbo, south to Talcahuano Bay, Chile. —Heath, *Mem. Mus. Roy. d'Hist. Nat. Belg.*, Ser. 2, Fasc. 10, 1937, p. 5, pl. 10, fig. 87 (Anatomy). Talchano [?Talcahuano], Chile.

*Solenella norrisii* Sowerby, *Proc. Zool. Soc. London* for 1832 (issued March 13, 1833), p. 197. "Hab. ad Valparaiso." "Discovered by Mr. Cuming, in soft mud, at from fourteen to forty-five fathoms depth." —Sowerby, *Gen. Shells*, Vol. 2, pl. 237 (four figs.), ?1833. "Dredged by Mr. H. Cuming at Valparaiso." —Reeve, *Conch. Syst.*, Vol. 1, 1841, p. 48, pl. 30, figs. 1-4. —Hanley, *Cat. Rec. Biv. Shells*, p. 17, 1843, p. 337, 1856?, Suppl. 10, figs. 8, 1843. —d'Orbigny, *Voy. Amer. Mèrid.*, Vol. 5, 1846, p. 543. Dredged in 10 fathoms in the Bay of Valparaiso, Chile. —Woodward, *Man. Moll.*, 1851-1856, p. 270, pl. 17, fig. 22. Ed. 2, 1868, p. 429, pl. 17, fig. 22. Reprint of Ed. 4 (1880), 1910, p. 429, pl. 17, fig. 22. Valparaiso, Chile. —Hupé, *Hist. de Chiles*, *Zool.*, Vol. 8, 1854, p. 306. Various parts of the coast of Chile. —Deshayes, *Traite Elem. Conchyl.*, Vol. 2, 1839-1857 [-1858], p. 270, pl. 34, figs. 5, 6, 7. Valparaiso, Chile. —Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 164, pl. 226 (*Nuculidae* pl. 1), figs. 1 and 2. Valparaiso, Chile.

*Solenella norrisii* Sowerby var. *brevior* Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 164, pl. 226 (*Nuculidae*, pl. 1). Valparaiso, Chile.

*Type Locality*: Valparaiso, Chile, in 14 to 45 fathoms, mud.

*Range*: Coquimbo to Talcahuano Bay, Chile.

Shell subovate, somewhat compressed, with polished olivaceous epidermis; beaks anterior to the middle; unornamented except by lines of growth; hinge with teeth very fine and very numerous posteriorly but very few anteriorly.

<sup>100</sup> *Solenella gigantea* E. A. Smith, *Ann. & Mag. Nat. Hist.*, Ser. 4, Vol. 16, 1875, p. 72. "Hab. Royal Sound, Kerguelen's Island." —E. A. Smith, *Phil. Trans. Roy. Soc. London*, Vol. 168, 1879, p. 187, pl. 9, fig. 19. Royal Sound, both at Observatory Bay and near the eastern shore of Swain's Harbour, on mud in about 10 fathoms.

*Malletia gigantea* E. A. Smith, E. A. Smith, *Sci. Res. Voy. Challenger*, *Zool.*, Vol. 13, Lamell., 1885, p. 244. Betsy Cove, Kerguelen Island, in shallow water; also at Balfour Bay, in 20 to 60 fathoms. —Lamy, *Bull. Mus. Nat. d'Hist. Nat. (Paris)*, Vol. 12, 1906, p. 203. Kerguelen Islands. —Lamy, *Bull. Mus. Nat. d'Hist. Nat. (Paris)*, Vol. 21, no. 2, 1915, p. 76. Several localities in Kerguelen Islands.

<sup>101</sup> *Yoldia subaequilateralis* E. A. Smith, *Ann. & Mag. Nat. Hist.*, Ser. 4, Vol. 16, 1875, p. 73. "Hab. Swain's Bay, Kerguelen's Island." —E. A. Smith, *Phil. Trans. Roy. Soc. London*, Vol. 168, 1879, p. 187, pl. 9, fig. 18. Swain's Bay. Dredged in 7-10 fathoms in very sheltered water.

Subgenus **Neilo** H. & A. Adams.

*Neilo* A. Adams, *Proc. Zool. Soc. London*, 1852, p. 93. Sole species: *Neilo cumingii* A. Adams. "It is from the shores of New Zealand." —H. & A. Adams, *Gen. Rec. Moll.*, Vol. 2, 1858, p. 549. —Verrill & Bush, *Amer. Jour. Sci.*, Ser. 4, Vol. 3, 1897, p. 57. Type: *N. cumingii* Adams. —Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, 1898, p. 877. Type: *Neilo cumingii* Adams. —Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, pt. 4, 1898, p. 581. Type: *N. australis* Quoy & Gaimard (+*N. cumingii* A. Adams). —Suter, *Man. New Zealand Moll.*, 1913, p. 837. Type: *N. cumingii* A. Adams = *australis* Quoy & Gaimard.

Type (by monotypy): *Neilo cumingii* A. Adams. [*Proc. Zool. Soc. London*, 1852, p. 93. "It is from the shores of New Zealand." —H. & A. Adams, *Gen. Rec. Moll.*, Vol. 2, 1858, p. 549, pl. 126, figs. 7, 7a, 7b. —Chenu, *Man. de Conchyl.*, Vol. 2, 1862, p. 181, fig. 914. —Suter, *Man. New Zealand Moll.*, 1913, p. 837, pl. 58, figs. 2, 2a (as *Malletia australis* Quoy & Gaimard). New Zealand].

The subgenus *Neilo* differs from *Malletia* in the ark-like form and in that the surface of the valves is usually ornamented by concentric sculpture.

*Neilo* has been recorded from late Cretaceous to Recent in Patagonia, from the Helvetian, Miocene, of France, and from upper Oligocene to Recent in New Zealand. The species described as *Nucula abrupta* by Conrad from the Miocene of Astoria, Oregon, was later referred to *Neilo*, but, there is some doubt as to the generic assignment of the species. One species assigned to *Neilo* has been described from deep water off tropical western North America.

*Spineilo* Finlay & Marwick<sup>102</sup>, with the type *Malletia elongata* Marshall from the Wangaloan (Danian) of New Zealand, was proposed as a subgenus of *Neilo*, the latter considered by them as of generic status.

***Malletia (Neilo) goniura* Dall.**

*Malletia goniura* Dall, *Proc. U. S. Nat. Mus.*, Vol. 12, 1889, p. 251, pl. 10, fig. 10. U. S. Fish Commission station 2793, "off the coast of Ecuador in 741 fathoms, mud; bottom temperature 38°.4 F."

*Malletia (Neilo)* [typ. error for *Neilo*] *goniura* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 386, pl. 18, fig. 6. U. S. S. *Albatross* station 3360. Gulf of Panama, in 1672 fathoms, sand, bottom temperature 42° F. Also original locality cited.

Type Locality: Off the coast of Ecuador, in 741 fathoms, mud.

Range: Gulf of Panama to off the coast of Ecuador, in deep water.

This is a thin fragile shell on which two ridges radiate from the beak to the truncate posterior margin. Hinge of type described as possessing 19 anterior and 25 posterior teeth. Another specimen described by Dall from the Gulf of Panama apparently had 14 anterior and over 30 posterior teeth.

Subgenus **Minormalletia** Dall.

*Minormalletia* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 385. Sole species: *Malletia (Minormalletia) arciformis* Dall.

Type (by monotypy): *Malletia (Minormalletia) arciformis* Dall.

Shell small, blunt, plump, with amphidetic ligament, no resilium, the pallial sinus large, no radial depressions or sculpture (Dall).

Marwick<sup>103</sup> has recorded *Minormalletia* from the medial Tertiary of New Zealand.

<sup>102</sup> *Spineilo* Finlay & Marwick, *Geol. Surv. New Zealand, Palaeo. Bull.* No. 15, May 20, 1937, p. 17. "Genotype: *Malletia elongata* Marshall, Wangaloan (Danian), New Zealand," p. 17, pl. 1, figs. 4 and 5. "Wangaloa (Type), common; Boulder Hill, common." Danian, upper Cretaceous.

<sup>103</sup> Marwick, J., *Geol. Surv. New Zealand, Palaeo. Bull.* No. 13, 1931, p. 55.

***Malletia (Minormalletia) arciformis* Dall.**

*Malletia (Minormalletia) arciformis* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 385, pl. 15, figs. 5 and 6. U. S. S. *Albatross*, station 3417, "off Acapulco, Mexico, in 493 fathoms, mud, bottom temperature 40°.6 F."

*Type Locality*: Off Acapulco, Mexico, in 493 fathoms, mud.

*Range*: Known only from the type locality.

The pallial sinus is notable in that the greater part of its basal scar is identical with the pallial line itself, whereas in most of the *Malletinae* the sinus tends to slope obliquely upward (Dall).

Dall pointed out that the profile of this species, although more rounded below and behind, is somewhat similar to that of *Arca adamsii* (Shuttleworth (MS)) E. A. Smith, a Caribbean species.

***Malletia (Minormalletia) benthima* Dall.**

*Malletia (Minormalletia) benthima* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 386, pl. 15, figs. 1 and 2. U. S. S. *Albatross* station 3417, "off Acapulco, Mexico, in 493 fathoms, mud, bottom temperature 40°.6 F."

*Type Locality*: Off Acapulco, Mexico, in 493 fathoms, mud. Type No. 122,927 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell small, thin, very inequilateral; hinge with 12-13 anterior and 17-18 posterior teeth.

The subgeneric position of the following species of *Malletia* is uncertain.

***Malletia faba* Dall.**

*Malletia faba* Dall, *Nat. Hist. Soc. Brit. Columbia, Bull.* No. 2, January, 1897, p. 10, pl. 2, fig. 10. "Off Sea Lion Rock, coast of Washington, in 477 fms.; off Queen Charlotte Islands, British Columbia, in 876 fms.; off Tillamook in 786 fms.; off San Diego, Cal., in 822 fms., U. S. Fish Commission." —Dall, Checklist Rec. Bivalve Moll., (Southwest Museum), 1916, p. 13. Queen Charlotte Islands, Brit. Columbia, to Lower California. —Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 14. Queen Charlotte Islands, British Columbia, to Lower California. —I. S. Oldroyd, *Stanford Univ. Publ. Univ. Ser. Geol. Sci.*, Vol. 1, 1924, p. 37, pl. 13, fig. 16. Range same as cited by Dall. —Keen, Check List West North Amer. Mar. Moll., (Stanford Univ. Press), 1937, p. 22. Range: Lat. 30°-54° N.

*Type Locality*: Off Sea Lion Rock, Washington, in 477 fathoms. Type No. 122,569 U. S. Nat. Mus.

*Range*: Queen Charlotte Islands, British Columbia, to Lower California.

Shell thin, ovate, inflated, smooth, slightly inequilateral; hinge with about 9 small posterior and about 32 anterior teeth.

***Malletia inequalis* Dall.**

*Malletia inequalis* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 383. U. S. S. *Albatross* station 2772, "off Cape Virgins, in 31 fathoms, sand, and 2778, Straits of Magellan, in 61 fathoms, mud, bottom temperature 47°.9 F."

*Type Locality*: Off Cape Virgins, in 31 fathoms, sand, and Straits of Magellan, in 61 fathoms, mud. [Type locality here designated as off Cape Virgins, in 31 fathoms, sand].

*Range*: Off Cape Virgins, and Straits of Magellan.

The truncation behind, the coalescent pallial sinus, and the compressed form separate it from the other species (Dall). Hinge with 3 anterior and 24 posterior teeth.

***Malletia magellanica* E. A. Smith.**

*Malletia magellanica* E. A. Smith, *Proc. Zool. Soc. London*, 1881, p. 39, pl. 5, figs. 3, 3a. "Hab. Station 3, Mayne Harbour, 9 fathoms, greenish mud; and Cockle Cove, 2-32 fathoms, mud." —Mabille & Rochebrune, *Miss. Sci. Cap. Horn*, *Moll.*, Vol. 6, Zool., Pt. 2, 1889, p. H 114. Mayne Harbor; Cockle Cove (E. Smith).

*Type Locality*: Mayne Harbor and Cockle Cove, Chile.

*Range*: Straits of Magellan and Magellanic region.

***Malletia patagonica* Mabille & Rochebrune.**

*Malletia patagonica* Mabille & Rochebrune, *Miss. Sci. Cap. Horn*, Vol. 6, Zool., pt. 2, 1889, p. H 114, pl. 8, fig. 1. "Hab. —Punta-Arenas."

*Malletia hyadesi* Mabille & Rochebrune, *Miss. Sci. Cap. Horn*, Vol. 6, Zool., pt. 2, 1889, p. H 114. "Hab. —Punta-Arenas."

*Malletia magellanica* Mabille & Rochebrune, Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 383 (at least in part). Punta Arenas. Also off Cape Virgins, in 31½ fathoms, and Magellan Straits, in 77 fathoms.

Not *Malletia magellanica* E. A. Smith.

*Type Locality*: Punta Arenas, Chile.

*Range*: Southern Chile in the Magellanic region.

***Malletia peruviana* Dall.**

*Malletia peruviana* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 384, pl. 10, figs. 3 and 5. U. S. S. *Albatross* station 4654, "N. 68° W., twenty-four miles from Aguja Point, Peru, in 1036 fathoms, mud, bottom temperature 37°.3 F."

*Type Locality*: Twenty-four miles N. 68° W., from Aguja Point, Peru, fathoms, ooze. Type No. 122,906 U. S. Nat. Mus.

*Range*: Known only from the type locality.

This species is remarkable for its almost blackish color and extremely shallow pallial sinus, which does not extend in front of the posterior adductor scar; the anterior end is unusually short and almost pointed (Dall). Hinge with about 10 anterior and 33 posterior teeth.

***Malletia truncata* Dall.**

*Malletia truncata* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 384, pl. 17, fig. 1. U. S. S. *Albatross* station 3374, "southwest of Malpelo Island, Gulf of Panama, in 1823 fathoms, ooze, bottom temperature 36°.4 F." Also at station 3361, in 1471 fathoms, and station 3381, in 1772 fathoms.

*Type Locality*: Southwest of Malpelo Island, Gulf of Panama, in 1,823 fathoms, ooze. Type No. 122,906 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Remarkable for its light yellow color, its surface devoid of radial sculpture or indented margin, and its bluntly truncate posterior end. In the latter character and its subequal division of the hinge teeth it recalls *Neilo*, but is without the rostration of that form (Dall). Hinge with 20 anterior and about 27 posterior teeth.



Genus *Tindaria* Bellardi.

*Tindaria* Bellardi, Monogr. Nuculidi Terr. Terz. del. Piemonte e Liguria, 1875, p. 28. Sole species: *Tindaria arata* Bellardi. ———Verrill & Bush, *Proc. U. S. Nat. Mus.*, Vol. 20, 1898, p. 880. Type: *Tindaria arata* Bellardi. ———Dall, *Trans. Wagner Free Inst. Sci.*, Vol. 3, pt. 4, April, 1898, p. 581. Type: *T. arata* Bellardi. ———Sacco, Moll. Terr. Terz. Piemonte e Liguria, Pt. 26, December, 1898, p. 64. "(Tipo *T. arata* Bell.)" ———Cossmann & Peyrot, *Act. Soc. Linn. Bordeaux*, Vol. 66 (Conch. Neog. Aquit., Vol. 2, Livr. 1), 1912, p. 125. Genotype: *Tindaria arata* Bellardi. ———Woodring, *Carnegie Inst. Washington, Publ.* 366, 1925, p. 23. Type: *Tindaria arata* Bellardi.

Type (by monotypy): *Tindaria arata* Bellardi. [Mon. Nuculid. Terr. Terz. Piemonte e Liguria, 1875, p. 28, fig. 27. ———Sacco, Moll. Terr. Terz. Piemonte e Liguria, Pt. 26, December, 1898, p. 64, pl. 12, figs. 55, 56. Helvetian and Tortonian of Italy].

Shell small, veneriform, strongly inflated; beaks turned forward; sculptured by concentric rugae of varying development; ligament external, opisthodontic; hinge uninterrupted below umbo, posterior series of teeth strongly curved, the anterior series of teeth are heavier, shorter and straighter; pallial sinus moderately developed, narrowly triangular.

*Tindaria* is known from the Miocene of France and Italy and Miocene to Recent in the Caribbean region. It is not known to occur with certainty in the Tertiary of the western Americas but several species have been described from west American waters between Sitka, Alaska, and Cape Horn.

Subgenus *Tindariopsis* Verrill & Bush.

*Tindariopsis* Verrill & Bush, *Amer. Jour. Sci.*, Ser. 4, Vol. 3, 1897, p. 59. "Type *T. agathida* (Dall)."

Type (by original designation): *T. agathida* (Dall). [= *Malletia* (*Tindaria*) *agathida* Dall, *Proc. U. S. Nat. Mus.*, Vol. 12, 1889, p. 252, pl. 13, fig. 10. South from St. Kitts, in 687 fathoms, east from Tobago, in 880 fathoms].

This subgenus was proposed for species with ovate shells, with a short rostrum, defined by a radial ridge and a furrow.

*Tindaria* (*Tindariopsis*) *sulculata* Gould.

*Nucula sulculata* Couthouy, Gould, *U. S. Explor. Exped.*, Vol. 12, 1852, p. 424, Atlas, 1856, pl. 37, figs. 539a-e. Orange Harbor, Patagonia.

*Leda sulculata* Couthouy, Hanley, *Thes. Conch.*, Vol. 3, 1860, p. 129 footnote. ———Mabille & Rochebrune, *Miss. Sci. Cap. Horn*, Vol. 6, Zool., Pt. 2, 1889, p. H 113. Cape Horn. Orange Bay. ———Stempel, *Sitzungsber. Kön. Preuss. Akad. Wiss. Berlin*, Jahrg. 1897, pp. 17-28. ———Stempel, *Zool. Jahrb.*, Bd. 4 (Fauna Chilensis, Bd. 1), Heft 2, July 1, 1898, p. 343 (and following pages), pl. 22, figs. 1, 5, 6, 7, 8, 10, 11; pl. 23, figs. 19, 21; pl. 24, figs. 23, 24, 25, 26, 28, 29, 30, 31; pl. 25, figs. 33, 34, 35, 36, 37, 38, 40, 41, 43 (anatomy).

Not *Lembulus sulculatus* Risso, *Hist. Nat. Europ. Merid.*, Vol. 4, 1826, p. 320.

*Leda lugubris* A. Adams, *Proc. Zool. Soc. London*, 1856, p. 49. "Hab. . . . . ? Mus. Cuming." ———E. A. Smith, *Proc. Zool. Soc. London*, 1881, p. 39. Port Rosario in 2-30 fathoms; Wolsey anchorage, in 17 fathoms. ———Mabille & Rochebrune, *Miss. Sci. Cap. Horn*, Vol. 6, Zool., Pt. 2, 1889, p. H 113. Port Rosario (E. Smith).

*Leda orangica* Mabille & Rochebrune, *Miss. Sci. Cap. Horn*, Vol. 6, Zool., Pt. 2, 1889, p. H 113, pl. 8, fig. 3. "Hab. Baie Orange."

*Tindaria* (*Tindariopsis*) *sulculata* Gould, Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 390. Straits of Magellan. Also earlier records.

Type Locality: Orange Harbor, Chile.

*Range*: Cape Horn and Straits of Magellan.

The subgeneric position of the following species of *Tindaria* is uncertain.

### ***Tindaria atossa* Dall.**

*Tindaria atossa* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 388, pl. 15, figs. 3 and 4. U. S. S. *Albatross*, station 3392, "Gulf of Panama, in 1270 fathoms, hard bottom, temperature 36°.4 F." Also at station 3393, Gulf of Panama, in 1020 fathoms.

*Type Locality*: Gulf of Panama, in 1,270 fathoms, hard bottom. Type No. 122,920 U. S. Nat. Mus.

*Range*: Gulf of Panama.

Shell small, olivaceous, moderately polished, finely concentrically striated all over, with the beaks slightly anterior, the posterior end bluntly pointed, the anterior rounded; ligament small, amphidetic; anterior teeth six, posterior ten, the dorsal slopes gently, the basal margin roundly arcuate; interior white, margin entire. Measurements of the type: Length, 6.5 mm.; height, 4.5 mm.; maximum diameter, 3.0 mm. (From Dall).

*Tindaria atossa* resembles *T. panamensis* but the whole surface is sculptured and the posterior end is less elongated and pointed.

### ***Tindaria compressa* Dall.**

*Tindaria compressa* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 387, pl. 15, figs. 7 and 8; pl. 17, figs. 15 and 16. U. S. S. *Albatross* station 3360, "in 1672 fathoms, sand, bottom temperature 42° F." Also at station 3414, "southwest of the isthmus of Tehuantepec, in 2232 fathoms, green mud, bottom temperature 38°.5 F."

*Type Locality*: Lat. 6° 17' 00" N., Long. 82° 5' 0" W., in 1,672 fathoms, sand. Type No. 122,921 U. S. Nat. Mus.

*Range*: Southwest of the Isthmus of Tehuantepec to the Gulf of Panama, in deep water.

Shell small, thin, cythereiform, inequilateral, concentrically striated; hinge with 10-12 anterior and 21-25 posterior teeth.

*Tindaria amabilis* Dall<sup>104</sup> of the Antilles is a somewhat similar species.

### ***Tindaria panamensis* Dall.**

*Tindaria panamensis* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 388, pl. 17, figs. 10 and 12. U. S. S. *Albatross*, station 3392, "Gulf of Panama, in 1270 fathoms, hard bottom, temperature 36°.4 F."

*Type Locality*: Gulf of Panama, in 1,270 fathoms, hard bottom. Type No. 122,922 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Surface with fine concentric threads which become much finer on the posterior third of the shell; hinge with 7 anterior and about 13 posterior teeth. Dimensions of type; length, 5.5 mm.; height, 4.3 mm.; maximum diameter 2.8 mm.

The more greenish color and dull surface of this species are said to be characteristic in comparison to similar species.

<sup>104</sup> *Malletia* (*Tindaria*) *amabilis* Dall, *Bull. Mus. Comp. Zool.*, Vol. 18, June, 1889, p. 438, pl. 40, fig. 8. —Dall, *Proc. U. S. Nat. Mus.*, Vol. 12, 1889, p. 252. In 607 fathoms, off St. Kitts, and in 880 fathoms east of Tobago.

*Tindaria* sp.<sup>105</sup>, cited by Woodring from the Miocene of Bowden, Jamaica, is said to possess a similar shell but it is shorter and the posterior end is more inflated.

### ***Tindaria mexicana* Dall.**

*Tindaria mexicana* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 389, pl. 17, figs. 11 and 14. U. S. S. *Albatross*, station 3418, "off the Mexican coast in 660 fathoms, sand, bottom temperature 39° F."

*Type Locality*: Off the Mexican coast, in 660 fathoms, sand. Type No. 122,925 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Very similar to *T. smirna*, but with more prominent beaks; shorter and blunter, in proportion to height, and decidedly less pointed and produced behind (Dall). Hinge with 11 anterior and about 21 posterior teeth.

### ***Tindaria salaria* Dall.**

*Tindaria salaria* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 387. "Dredged in Mid-Pacific, off Salar y Gomez Island, at U. S. S. *Albatross*, station 4693, in 1142 fathoms, manganese nodules, bottom temperature 35°.4 F."

*Type Locality*: Off Sala y Gomez, West of Chile, in 1,142 fathoms, manganese nodules.

*Range*: Known only from the type locality.

The shell of this species, in its general exterior characteristics, is said to resemble that of *Nucula proxima* Say.

### ***Tindaria smirna* Dall.**

*Tindaria smirna* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 389, pl. 17, figs. 6 and 7. U. S. S. *Albatross*, station 3360, "Gulf of Panama, in 1672 fathoms, sand, bottom temperature 42° F."

*Type Locality*: Gulf of Panama, in 1,672 fathoms, sand. Type No. 122,919 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Shell small, polished, subtriangular, of a blackish olive tint; smooth over two thirds of the surface, but near the basal margin there are about 10 concentric grooves crossed by very fine radial striae; hinge with about 8 anterior and 12 posterior teeth. Length 5.5 mm.; height, 4.0 mm.; maximum diameter, 2.7 mm.

Close to *T. atossa*, but much more brilliantly polished, the shell shorter, more turgid, more nearly equilateral, and with the ligament distinctly and subequally amphidetic, while in *T. atossa* it appears, to the naked eye, to be entirely opisthodontic, though on opening the valves a small portion is seen to pass in front of the beaks (Dall).

### ***Tindaria thea* Dall.**

*Tindaria thea* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 390. U. S. S. *Albatross*, station 4654, "N. 68° W., twenty-four miles from Aguja Point, Peru, in 1036 fathoms, mud, bottom temperature, 37°.3 F."

<sup>105</sup> *Tindaria* (*Tindaria*) sp., Woodring, *Carnegie Inst. Washington, Publ.* 366, May, 1925, p. 23, pl. 1, figs. 22, 23. Bowden, Jamaica; Miocene.

*Type Locality*: 24 miles northwest of Aguja Point, Peru, in 1,036 fathoms, mud. Type No. 110,577 U. S. Nat. Mus.

*Range*: Known only from the type locality.

Just about the color of dark, wet, tea-leaves after they have been steeped. Longer and more pointed, and more attenuated behind, than *T. smirna*, which has very similar sculpture but a more yellowish color. In looking from below, the series of hinge teeth seems uninterrupted, but the black color of the semi-internal resilium can be seen through the interstices, as it is situated above the tooth-line (Dall). Hinge with 8 anterior and 14 posterior teeth.

### *Tindaria virens* Dall.

*Malletia (Tindaria) virens* Dall, *Proc. U. S. Nat. Mus.*, Vol. 12, 1889, p. 254, pl. 13, fig. 3. "In 122 to 449 fathoms, mud, on the west coast of Patagonia; temperatures 47° to 50° F."

*Tindaria virens* Dall, *Bull. Mus. Comp. Zool.*, Vol. 43, no. 6, October, 1908, p. 389. Coast of Southern Chile and western Patagonia, in 122 to 449 fathoms.

*Type Locality*: West coast of Chile, in 122 to 449 fathoms, mud.

*Range*: Coast of southern Chile, in 122 to 449 fathoms.

Lighter colored, with alternating zones and with sharper and deeper concentric sulci, than those exhibited by *T. atossa* of the Panama fauna, which is the most nearly related species (Dall, 1908).

## EXPLANATION OF THE PLATES.

### PLATE I.

- Fig. 1. *Nucula (Nucula) declivis* Hinds. Length 5 mm., height 4 mm., thickness (both valves) 2.9 mm. Hypotype, left valve, from Station 203-D-1, dredged in 15 fathoms (27 meters), in Lat. 10° 56' 05" N., Long. 85° 49' 25" W., Port Parker, Costa Rica. P. 380.
- Fig. 2. *Nucula (Nucula) declivis* Hinds. Length 4.8 mm., height 3.8 mm., thickness 1.6 mm. Hypotype, right valve, from Station 145-D-1, dredged in 13 fathoms (24 meters) in Lat. 26° 52' N., Long. 111° 53' W., Santa Inez Bay, east coast of Lower California. View of the interior. P. 380.
- Fig. 3. *Nucula (Nucula) declivis* Hinds. Length 4.6 mm., width 3.4 mm., thickness (both valves) 2.7 mm. Hypotype, left valve, from the same locality as the specimen shown in Fig. 2. P. 380.
- Fig. 4. *Nucula (Nucula) exigua* Sowerby. Length 5.7 mm., height 5.4 mm., thickness (both valves) 3.9 mm. Hypotype, left valve, dredged at Loc. 27595 (C.A.S.), San Bartolome (Turtle Bay), Lower California. P. 381.
- Fig. 5. *Nucula (Nucula) exigua* Sowerby. View of posterior end of specimen shown in Fig. 4.
- Fig. 6. *Nucula (Nucula) declivis* Hinds. View of posterior end of specimen shown in Fig. 1.
- Fig. 7. *Nucula (Nucula) declivis* Hinds. View of specimen shown in Fig. 1 but with less magnification.
- Fig. 8. *Nucula (Nucolopsis) schencki* Hertlein & Strong, sp. nov. Length 2.0 mm., height 1.7 mm., thickness (both valves), 1.0 mm. Holotype, left valve, from Station 195-D-9, dredged in 7 fathoms (12.6 meters), Lat. 15° 44' 28" N., Long. 96° 07' 51" W., Port Guatulco, Mexico. P. 384.
- Fig. 9. *Nucula (Nucolopsis) schencki* Hertlein & Strong, sp. nov. Length 2.8 mm., height 2.5 mm. Paratype, right valve, from the same locality as the holotype shown in Fig. 8. View of the interior. P. 384.
- Fig. 10. *Nucula (Nucolopsis) schencki* Hertlein & Strong, sp. nov. Dorsal view of the holotype shown in Fig. 8.

- Fig. 11. *Nuculana (Saccella) acuta* Conrad. Length 8.6 mm., height 4.8 mm., thickness (both valves) 3.4 mm. Hypotype, left valve, dredged at a depth of two fathoms at Cedar Keys, Florida, H. Hemphill collector (Loc. 5710). P. 392.
- Fig. 12. *Nuculana (Saccella) elenensis* Sowerby. Length 13.6 mm., height 7.0 mm., thickness (both valves) 5 mm. Hypotype, left valve, from Station 196-D-17, dredged in 23 fathoms (42 meters) in Lat. 15° 45' N., Long. 96° 05' 34" W., Tangola-Tangola Bay, Mexico. P. 393.
- Fig. 13. *Nuculana (Saccella) callimene* Dall. Length 14.5 mm., height 8.9 mm., thickness (both valves) 6.5 mm. Hypotype, left valve, from 3 miles south of Blanco Island, Gulf of Nicoya, Costa Rica. P. 393.
- Fig. 14. *Nuculana (Saccella) elenensis* Sowerby. Length 16 mm., height 8.5 mm., thickness (both valves) 6.5 mm. Hypotype, left valve, from the same locality as the specimen shown in Fig. 2. P. 393.
- Fig. 15. *Nuculana (Saccella) elenensis* Sowerby. Dorsal view of specimen shown in Fig. 14.
- Fig. 16. *Nuculana (Saccella) elenensis* Sowerby. Length 13.3 mm., height 6.8 mm., thickness (both valves) 4.8 mm. Hypotype, left valve, from the same locality as the specimen shown in Fig. 12. P. 393.
- Fig. 17. *Nuculana (Saccella) elenensis* Sowerby. Reproduction of figure of *Leda elenensis* Sowerby given by Hanley, Thes. Conch., Vol. 3, 1860, pl. 228 (*Nuculidae*, pl. 3), fig. 70. Panama.
- Fig. 18. *Nuculana (Saccella) elenensis* Sowerby. Reproduction of figure of *Leda elenensis* Sowerby given by Hanley, Thes. Conch., Vol. 3, 1860, pl. 228 (*Nuculidae*, pl. 3), fig. 71. Panama.
- Fig. 19. *Nuculana (Saccella) elenensis* Sowerby. Reproduction of figure of *Leda elenensis* Sowerby given by Hanley, Thes. Conch., Vol. 3, 1860, pl. 228 (*Nuculidae*, pl. 3), fig. 72. Panama.
- Fig. 20. *Nuculana cuneata* Sowerby. Reproduction of figure of *Leda cuneata* Sowerby given by Hanley, Thes. Conch., Vol. 3, 1860, pl. 228 (*Nuculidae*, pl. 3), fig. 93. "Valparaiso." [Not the record "New Guinea!"]. Dorsal view. P. 403.
- Fig. 21. *Nuculana cuneata* Sowerby. Reproduction of figure of *Leda cuneata* Sowerby given by Hanley, Thes. Conch., Vol. 3, 1860, pl. 228 (*Nuculidae*, pl. 3), fig. 92. Right valve. Same locality as cited for Fig. 20.
- Fig. 22. *Nuculana (Saccella) elenensis* Sowerby. Length 15.5 mm., height 8.1 mm. Hypotype, left valve, from the same locality as the specimen shown in Figs. 12 and 16. View of the interior. P. 393.

Figs. 12, 14-19, 22, illustrate the variability of *Nuculana elenensis*. Fig. 14 is a typical *N. acapulcensis* Pilsbry & Lowe but in view of the variability of the species we have considered these all to be referable to *N. elenensis*.

All the specimens illustrated on the plate except those shown in figures 17, 18, 19, 20, 21, are in the type collection of the Department of Paleontology of the California Academy of Sciences.

#### PLATE II.

- Fig. 1. *Nuculana (Saccella) eburnea* Sowerby. Length 12.4 mm., height 6.5 mm. Hypotype, right valve, from Station 199-D-1, dredged in 16 fathoms (29 meters) in Lat. 13° 18' N., Long. 87° 43' W., Meanguera Island, Gulf of Fonseca, El Salvador. P. 395.
- Fig. 2. *Nuculana (Saccella) eburnea* Sowerby. Length 11.2 mm., height 6 mm., thickness (both valves) 4.4 mm. Hypotype, left valve, from the same locality as the specimen shown in Fig. 1. P. 395.
- Fig. 3. *Nuculana (Saccella) eburnea* Sowerby. Length 13.3 mm., height 6.6 mm. Hypotype, left valve, from the same locality as the specimens shown in Figs. 1 and 2. View of the interior. P. 395.
- Fig. 4. *Nuculana (Saccella) laeviradius* Pilsbry & Lowe. Length 7.8 mm., height 4.4 mm., thickness (both valves) 3.6 mm. Hypotype, right valve, from

Station 145-D-1, -3, dredged in 4-13 fathoms (7.5-2.4 meters) in Lat. 26° 52' N., Long., 111° 53' W., Santa Inez Bay, east coast of Lower California. P. 396.

This illustration shows a comparatively smooth specimen in contrast to the one with strong concentric sculpture shown in Fig. 7.

Fig. 5. *Nuculana (Saccella) gibbosa* Sowerby. Length 36.8 mm., height 18.9 mm., thickness (one valve) 8.2 mm. Hypotype, left valve, from Station 213-D-11-17, dredged in 35 fathoms (63.7 meters) in Lat. 9° 44' 52"—9° 42' N., Long. 84° 51' 25"—84° 56' W., off Ballenas Bay, Gulf of Nicoya, Costa Rica. P. 395.

Fig. 6. *Nuculana (Saccella) impar* Pilsbry & Lowe. Length, 14.6 mm., height, 7.6 mm., thickness (both valves), 6.3 mm. Hypotype, right valve, from Loc. 23802 (C.A.S.), San Luis Gonzaga Bay, east coast of Lower California. P. 396.

The character of the ribbing, closely spaced near the beaks, widely spaced on the middle of the shell, then closely spaced near the base, is characteristic of this species.

Fig. 7. *Nuculana (Saccella) laeviradius* Pilsbry & Lowe. Length 6.0 mm., height 3.3 mm. Hypotype, right valve, from Loc. 23,802 (C.A.S.), San Luis Gonzaga Bay, east coast of Lower California. P. 396.

Fig. 8. *Nuculana (Saccella) gibbosa* Sowerby. Length 37.5 mm., height 19.8 mm., thickness (single valve) 7.9 mm. Hypotype, right valve, from the same locality as the specimen shown in Fig. 5. View of the interior. P. 395.

Fig. 9. *Nuculana (Politoleda) polita* Sowerby. Length 29.4 mm., height 14.0 mm., thickness (both valves, approximately) 9.6 mm. Hypotype, left valve, from Station 197-D-1, dredged in 14 fathoms (25 meters) in Lat. 14° 16' N., Long. 92° 03' W., 7 miles west of Champerico, Guatemala. P. 397.

Fig. 10. *Nuculana (Costelloleda) costellata* Sowerby. Length 22 mm., height 8.0 mm., thickness (both valves) 4.4 mm. Hypotype, left valve, from Station 143-D-1, dredged in 29 fathoms (53 meters) in Lat. 26° 58' 30" N., Long. 111° 57' 30", Santa Inez Bay, east coast of California. P. 398.

Fig. 11. *Adrana exoptata* Pilsbry & Lowe. Length 20.0 mm., height 6.0 mm., thickness (both valves, approximately) 3.0 mm. Hypotype, left valve, from Station 195-D-21, dredged in 18 fathoms (33 meters) in Lat. 15° 44' 45" N., Long. 96° 06' 55" W., Santa Cruz Bay, Mexico. P. 409.

Fig. 12. *Nuculana (Costelloleda) marella* Hertlein, Hanna & Strong, sp. nov. Length 32 mm., height 11.3 mm., thickness (both valves), 5.0 mm. Holotype, right valve, apparently from the Gulf of California. P. 399.

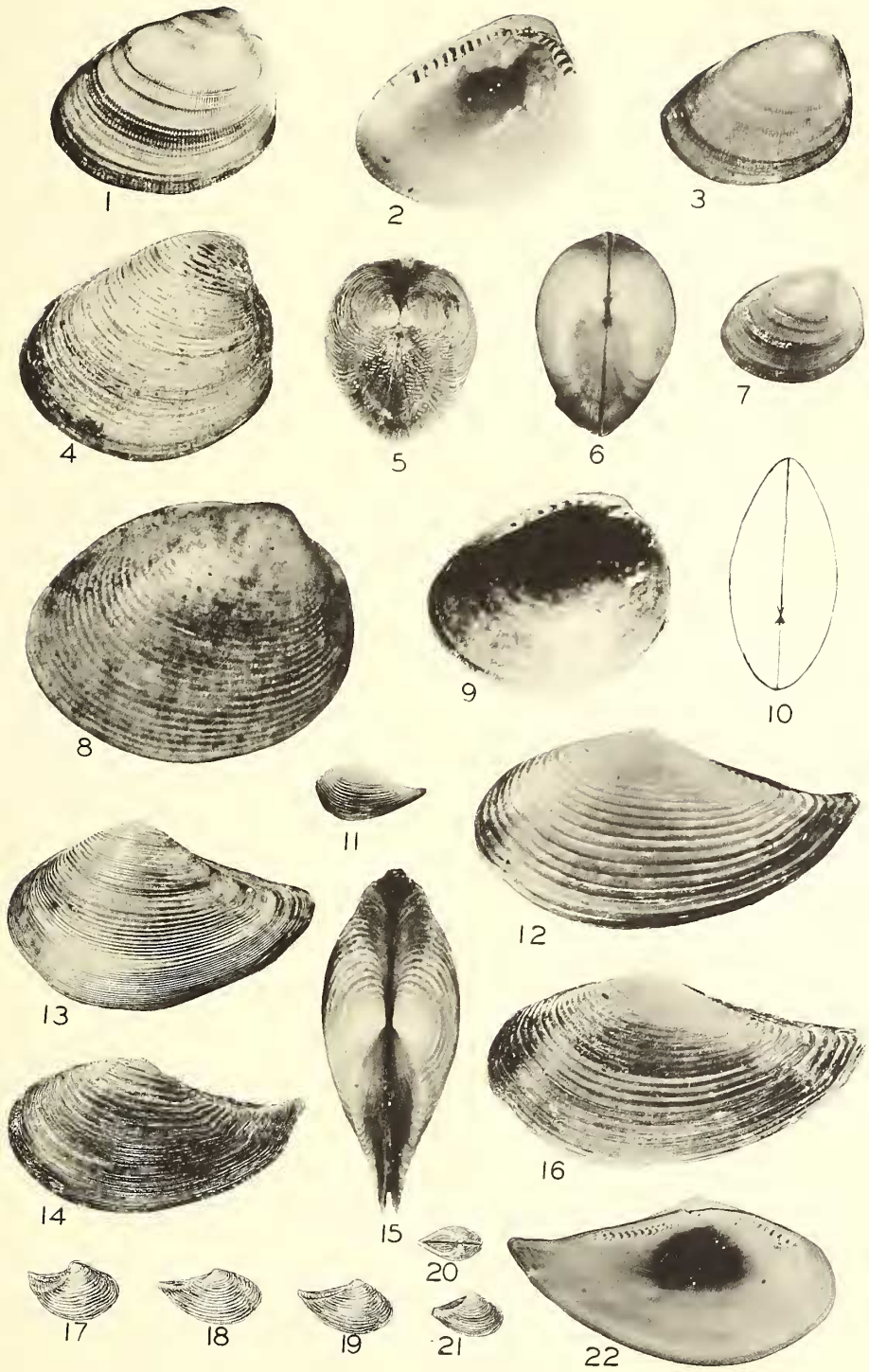
Fig. 13. *Nuculana (Costelloleda) marella* Hertlein, Hanna & Strong, sp. nov. View of interior of left valve of holotype.

Fig. 14. *Nuculana (Thestyleleda) hamata* Carpenter. Length, 12.0 mm., height, 7.2 mm. Hypotype, left valve, from Station 126-D-12, dredged in 45 fathoms (82 meters) in Lat. 28° 20' N., Long. 115° 10' 30" W., east of Cedros Island, Lower California, Mexico. P. 400.

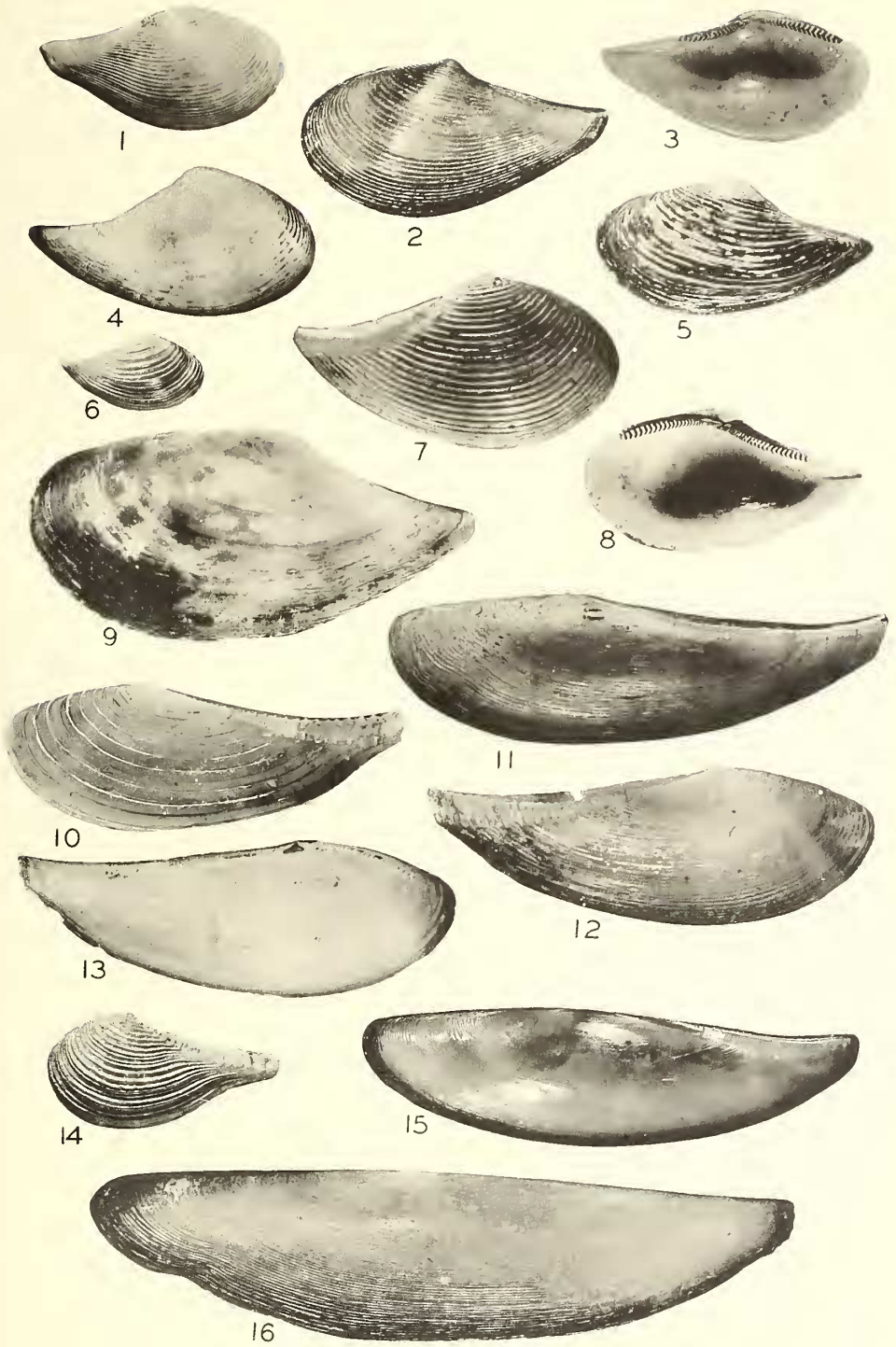
Fig. 15. *Adrana tonosiana* Pilsbry & Olsson. Length 33.1 mm., height 9.3 mm., thickness (both valves), 5.4 mm. Hypotype, left valve, from the same locality as the specimen shown in Fig. 9. P. 412.

Fig. 16. *Adrana elongata* Sowerby. Length 49.8 mm., height 12.0 mm., thickness (both valves) 5.5 mm. Hypotype, left valve, from Station 197-D-2, dredged in 14 fathoms (25 meters) in Lat. 14° 13' N., Long. 92° 02' W., 7 miles west of Champerico, Guatemala. P. 409.

All the specimens illustrated on this plate are in the type collection of the Department of Paleontology of the California Academy of Sciences.



MOLLUSKS FROM THE WEST COAST OF MEXICO AND CENTRAL AMERICA.



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